The Local Moving Channel: Learning from An Oil Crisis[*]

Elisa Giannone
CREI

Nuno Paixão
Bank of Canada

Xinle Pang
SUNY Buffalo

February 2024

Abstract

We study the “local moving channel,” defined as the spatial reallocation *across* neighborhood *within* the same labor market as a response to a negative labor market shock. Using granular longitudinal data that track addresses of almost all Canadian population, we find a surprisingly large moving response *within* labor markets to a negative local labor market shock proxied by a decline in global oil prices. We find an especially large response for the young, the renters and the low-ability-to-borrow. Movers are also more likely to move to locations with lower house prices. However, we don’t find a significant moving response to different labor markets. These results contradict most of the literature that has found little to no evidence of moving as a smoothing mechanism against local labor market shocks. We argue that accounting for “local moving” is paramount to understanding spatial reallocation response to labor market shocks. Through the lens of a dynamic life-cycle model embedded with location and wealth choices, we quantify how much of the “local moving channel” attenuates welfare losses from negative local shocks and test how the persistence of the shock alters the results.

---

[*] We want to thank Nikolai Lawrence and Adam Su for excellent research assistance. The views expressed in this paper are those of the authors and do not reflect those of the Bank of Canada.

1 Introduction

Over the last decades, labor markets have faced severe shocks from technological change, international trade, and, more recently, the COVID-19 pandemic. Presently, climate change stands out as one of the main threats to labor market stability in various parts of the world, with its significance expected to grow and extend to other regions. Looking ahead, the shift toward a greener economy will also affect sectors with high emissions and local labor markets tied to fossil energy extraction and production. These shocks in local labor markets can result in substantial factor reallocation, both within and between regions. As governments are increasingly called upon to enact policies that mitigate the adverse effects of such disruptions, understanding how individuals respond to these shocks has become more crucial than ever.

One margin of adjustment that is often discussed is geographic moving since it can help alleviate the impact of these shocks. While moving is often touted as a solution for deteriorating local economic conditions, there is limited and conflicting evidence regarding how individuals actually relocate in response to local labor market disturbances. For instance, during the sovereign debt crisis, there was anecdotal evidence of a significant influx of young individuals from southern to northern European countries. However, in response to the so-called China shock in the USA, which had significant economic implications, there was no strong evidence of substantial reallocation (e.g., Topalova 2010, Autor et al. 2014 and Dix-Carneiro and Kovak 2017).

In this paper, we contribute to this discussion by studying the "local moving channel" in response to negative labor market shocks. We depart from most of the literature by analyzing spatial reallocation across different labor markets and across neighborhoods *within* the same labor market. We argue that not accounting for this short-distance relocation decision underscores significantly the gains from moving as an insurance mechanism after a local shock. We do so by leveraging: i) a longitudinal dataset that contains individual-level information, including the history of addresses, for nearly all Canadian population; ii) the decline in global oil prices between 2014 and 2016 as a proxy for a local labor market shock in Canadian regions highly exposed to the oil industry; iii) a structural macro-spatial model to test the implications of removing the "local moving channel". First, we document the aggregate moving response to this shock. We find that not accounting for local moves would attenuate the moving response dramatically. We then show that young people, renters, and more financially constrained people move more in reaction to the shock. Individuals move, on average, to cheaper neighborhoods. Second, through the lens of a dynamic life-cycle spatial equilibrium model with income risk and wealth accumulated through two assets, we analyze the aggregate macroeconomic and welfare implications of local labor shocks and quantify the importance of the “local moving channel” in mitigating the adverse effects of these shocks.

Canada ranks as the world’s fifth-largest oil producer, with a significant concentration of production in the provinces of Alberta and Saskatchewan. This concentration renders specific local labor markets exceptionally vulnerable to fluctuations in global oil prices, which experienced a dramatic decline between 2014 and 2016. Despite being one of the world’s top five oil producers, Canada’s oil production constitutes a relatively modest share of global production, making oil price variations plausibly exogenous to the Canadian economy.

The exogenous variation in oil prices, combined with the variation in exposure to the oil sector across Canadian locations, makes oil price shocks a suitable proxy for labor market shocks. To identify areas and individuals highly exposed to the oil sector, we define *oil-dependent* labor markets as those within a 30-mile radius of oil sands or refineries. To do so, we manually identify the exact locations of refineries and oil sands in Canada. 95% of total output emanated from just three provinces: Alberta, Saskatchewan, Newfoundland, and Labrador.[1] We combine this identification strategy with granular data. We obtained access to *TransUnion Canada*, which is a credit bureau dataset that covers nearly every person in Canada with a credit report. It tracks individuals’ locations over time and includes individual demographic and financial characteristics.[2]

In the first part of the paper, we implement a difference-in-difference approach where we compare the *oil-dependent* labor markets (treatment group) and *non-oil-dependent* (control) labor markets within the oil provinces before and after 2015 on the propensity to relocate. Our primary objective is to investigate the moving response to local labor market shocks and explore variations across demographic groups.

The core results point to the prevalence of what we define as the “local moving” channel. When we define moving as the probability of moving to another labor market, the coefficient on the treatment effect is not statistically significant. This would lead the reader to think that, consistent with what other studies have found in other contexts, there was no spatial reallocation in the episode of the oil crisis. Instead, when we account for moving to other neighborhoods within the same labor market, we find striking results. The spatial reallocation response is statistically significant, but it is also quantitatively sizable. We find that negative labor market shocks induce out-moves from the most impacted areas, with out-moves increasing by 32% compared to the control group.

To understand the mechanisms, we explore heterogeneity and the direction of the moving

---

[1] In Newfoundland and Labrador, most production takes place offshore, with production outside of these three provinces having minimal relevance to the local economy. Given that our identification relies on proximity to oil fields, our analysis is confined to the provinces of Alberta and Saskatchewan.

[2] We are unaware of other studies using this dataset to study the effects of local labor market shocks on location choices.

response. First, we find that the moving response is primarily driven by young individuals, renters, and those with limited access to financial markets, as indicated by their credit scores. The magnitude of the moving response is substantial. For those with credit scores below 640, the likelihood of migrating increases by a factor of eight compared to those with credit scores of 800 or above. This effect is particularly pronounced for individuals with credit scores below 640 in the impacted areas, where their likelihood of migrating increases by 50% relative to the period before the shock. Second, we find that those who move after the shock are more likely to move to areas with lower house prices than before the shock. In summary, our findings underscore the relevance of moving as a response to local shocks, particularly among financially constrained individuals. Movers are also more likely to move to neighborhoods with lower housing costs, potentially at the cost of lower amenities and other benefits.

Motivated by this evidence and particularly by the fact that local moving decisions to cheaper areas are the ones that drive our results, we employ a macro-spatial model to study how big is the role for the “local moving" ” channel in mitigating the welfare impact of the local shock. In more details, we employ a quantitative life-cycle spatial equilibrium model with uninsurable income risk and wealth accumulation similar to the one developed by Giannone et al. (2023). Locations are heterogeneous in terms of productivity, amenities, labor market risk and housing market characteristics. The economy is populated by overlapping generations of risk-averse households who face idiosyncratic income shocks and mortality risks during working years. Heterogeneous households endogenously accumulate wealth through liquid and illiquid assets. They can become homeowners by acquiring illiquid housing units and saving or borrowing through a one-period non-contingent liquid asset subject to a borrowing constraint. Since markets are incomplete, risk-averse households cannot perfectly hedge income and longevity risks, generating the standard precautionary saving motive. Every period, households make forward-looking decisions on location, tenure status (own or rent), non-housing and housing consumption and savings. There are moving frictions as moving is subject to monetary and utility moving costs. On the supply side, each location produces a tradable good using local labor subject to decreasing returns to scale. Productivity is endogenous as agglomeration forces drive productivity up with location size. The construction sector builds new additions to the local residential stock and a competitive sector manages rental units. Wages, house prices and rental prices in each location are endogenously determined in equilibrium.

We then take a 4-location version of the model and the data. We consider two regions that represent two distinct labor markets: an oil-intensive region and a non-oil-intensive region. Each region is composed of two different locations that differ in housing characteristics and amenities. For simplicity, we denote this within-region location as low- and high-house-price locations. Due to data limitations, the oil-intensive region does not match exactly the oil-intensive areas identified in the empirical section, although the structure and flexibility of the model would allow for it. Instead, we match the oil-intensive region to the provinces of Alberta and Saskatchewan. We calibrate the non-oil-intensive regions to the rest of the Canadian provinces. The low and high house price locations within each region match the neighborhoods with house prices below and above the median, respectively.

Through the lens of this model, we dissect how local aggregate shocks affect aggregate welfare and welfare inequality. We also quantify the importance of the moving channel in mitigating the adverse effects of these shocks. To do so, we simulate the negative shock analyzed empirically. Since we lack an oil sector in the model, we simulate an unexpected but temporary decline in productivity in the "oil-intensive" region. This decline in productivity is calibrated to match the observed income decline in Alberta and Saskatchewan between 2015 and 2017, with productivity gradually returning to its 2014 level afterward.

Finally, we compare the effects induced by a transitory labor market shock with those induced by a permanent one. While the oil price shock analyzed was temporary, the transition to a greener economy may have lasting repercussions for regions heavily dependent on the oil industry. Therefore, this counterfactual analysis allows us to assess potential disparities relative to a temporary shock. For instance, under a temporary shock, individuals with greater access to financial markets may utilize this channel to smooth out the shock's impact, thereby avoiding high utility-related moving costs. However, a permanent shock could lead to more substantial reallocation among high-wealth individuals without the need to use the “local moving" channel, potentially exacerbating long-term inequality.

Related Literature. This paper contributes to the broad literature studying geographic reallocation as a response to local labor market shocks. Trade shocks are found to have little to no impact on out-migration (e.g., Topalova 2010, Autor et al. 2014 and Dix-Carneiro and Kovak 2017). Yagan (2014) and Monras (2020) have analyzed the effects of the financial crisis on mobility, showing limited smoothing through moving across demographic groups. Bound and Johnson (1992) and Notowidigdo (2020) find a positive relationship between migration and local shocks, but mostly pronounced among high-skill workers. In contrast to these papers, we find a surprisingly large out-moving response, particularly among financially constrained individuals. At the same time, our findings are completely reconcilable with the papers above. In fact, when we aggregate the data to cities or larger areas, which would be the equivalent of commuting zones, we also find little to no response. Using a fully-fledged quantitative model, we can rationalize this large local moving response, especially by low-wealth individuals, and dissect its welfare and inequality implications. Furthermore, our framework enables us to shed light on the potential consequences should these types of shocks become permanent. Our findings align with new insights from Borusyak, Dix-Carneiro and Kovak (2022) that suggest that to assess the migration elasticities of a local shock, it is important to access granular data since shocks might be correlated across locations, attenuating reallocation choices. It is the granularity of our data that, indeed, allows us to show the “local moving¨ channel and, hence, to quantify its importance.

Relatedly, a very recent literature studies the migration response to climate change episodes and the transition to a greener economy. Albert, Bustos and Ponticelli (2021) find a sizable response to dryness in Brasil. Hanson (2023) conducts an analysis studying how the decline of the coal industry in 1980 affected employment, job loss and migration in highly exposed areas. There was a large decline in population over the following decades. While our shock is not related to the transition to greener energy or climate change directly, it also has the potential to speak to this literature. If the energy transition were to create an oil crisis as predicted, our results could teach a lesson. In particular, if the shock were permanent, as studied in our model, the local moving channel might be quite relevant in handling this shock.

The rest of the paper is divided into the following sections. Section 2 describes the Canadian context of the oil price collapse and the research design. Section 3 describes *Transunion* data and its fit for our experimental design. Section 4 develops the empirical specification and the main results. It then delves into the heterogeneity analysis and further mechanisms. Section 6 develops the theoretical framework. Section 7 shows how we solve the model, reports the estimation and the calibration strategy and the exercises we conduct with it. Finally, section 9 concludes.

2 The Oil Price Collapse as a Local Labor Market Shock in Canada

Canada is the fifth largest oil producer in the world, a sector of paramount importance to the Canadian economy. The nation predominantly exports its crude oil, rendering the oil industry and the broader Canadian economy highly susceptible to fluctuations in global oil prices. Despite being among the top five global oil producers, Canada’s oil output represents a relatively modest fraction of worldwide production, making oil price variations plausibly exogenous to the Canadian economy.

Furthermore, oil production in Canada exhibits significant geographic concentration, with a staggering 95% of total output emanating from just three provinces: Alberta, Saskatchewan, and Newfoundland and Labrador. Even within these designated *Oil Provinces*, there is considerable variation in the exposure of different areas to the oil industry. Consequently, variations in oil prices have disparate impacts on local labor markets. These distinctive characteristics of the Canadian oil sector make it particularly suitable for using changes in oil prices as proxies for local labor market shocks.

Oil Prices *Western Canadian Select (WCS)* is the reference price for heavy crude oil (e.g. blended bitumen) delivered at Hardisty, Alberta. WCS represents the oil price from the oil sands, the most common type of oil produced in Canada.[3] As in Kilian and Zhou (2018), we use WCS crude oil price measured in Canadian dollars that we obtain from the Canadian Association of Petroleum Producers.

Figure 1 presents the historical trajectory of the WCS crude oil price, measured both in nominal Canadian dollars and in real terms.[4] During the period from 2010 to 2014, the oil price remained relatively stable. However, there was a substantial drop of approximately 62 percent in oil prices between 2014 and 2016. While a gradual recovery began, by 2018, WCS still lingered at around 40 percent below its 2014 levels.

Figure 1: Oil Price Evolution

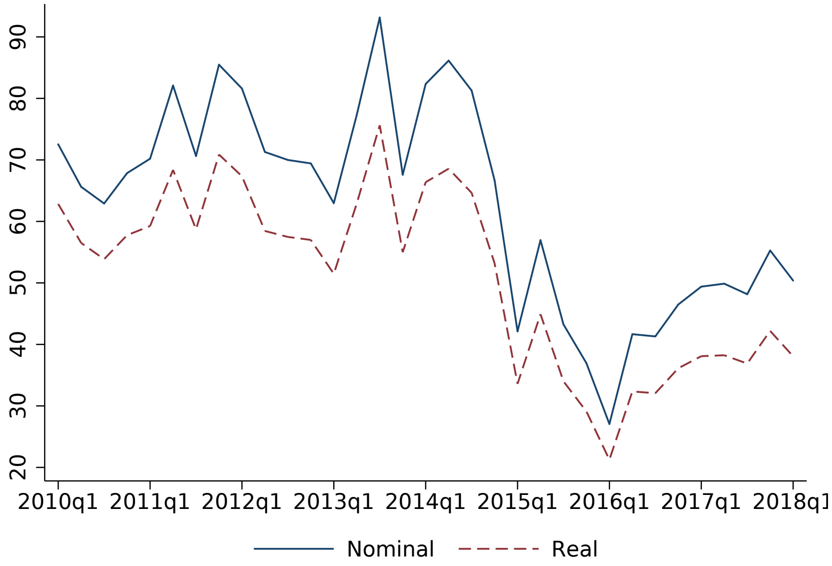


Figure 1 plots the WCS crude oil price measured in nominal Canadian dollars and in real terms. Real oil price is computed by deflating WCS by the national wide CPI. *Data Sources:* Canadian Association of Petroleum Producers and Statistics Canada.

The unexpected, substantial, and enduring decline in oil prices had a profound impact on the Canadian economy, especially in three key provinces often referred to as the *Oil provinces*.

---

[3] It takes more energy to produce refined products (e.g. gasoline) from heavy crudes, therefore, WCS trades at a discount to lighter crudes.

[4] Real oil price is computed by deflating WCS by the nationwide Canadian consumer price index (CPI) from Statistics Canada.

As highlighted earlier, Canada's share of the global oil market is relatively modest, making this substantial reduction in oil prices a substantial exogenous shock to labor markets and income in regions heavily reliant on the oil industry.

Oil Fields The majority of oil fields in Canada are situated near oil sands, which consist of a natural mixture of sand, water, and bitumen – a type of oil that is too dense to flow on its own. These oil sands are primarily found in three main regions within the provinces of Alberta and Saskatchewan: Athabasca, Cold Lake, and Peace River. Together, these regions cover an expansive area exceeding 142,000 square kilometers. While the oil sands are situated close to the surface near Fort McMurray, they are located at deeper underground levels in other regions.

Our analysis relies on the UCube Global Asset-Level Oil and Gas Database, a newly developed proprietary dataset compiled by Rystad Energy. This database provides comprehensive annual information on the location, production, reserves, operational costs, and investments associated with all oil and gas fields dating back to 1900. It encompasses approximately 80,000 assets operated by more than 3,500 companies worldwide.[5]

Figure 2 identifies the location of the oil fields in the provinces of Alberta and Saskatchewan with positive production in 2014. In Newfoundland and Labrador, most production takes place offshore, with production outside of these three provinces having minimal relevance to the local economy. Given that our identification relies on proximity to oil fields, our analysis is confined to the provinces of Alberta and Saskatchewan.

Figure 2: Oil Fields in Alberta and Saskatchewan

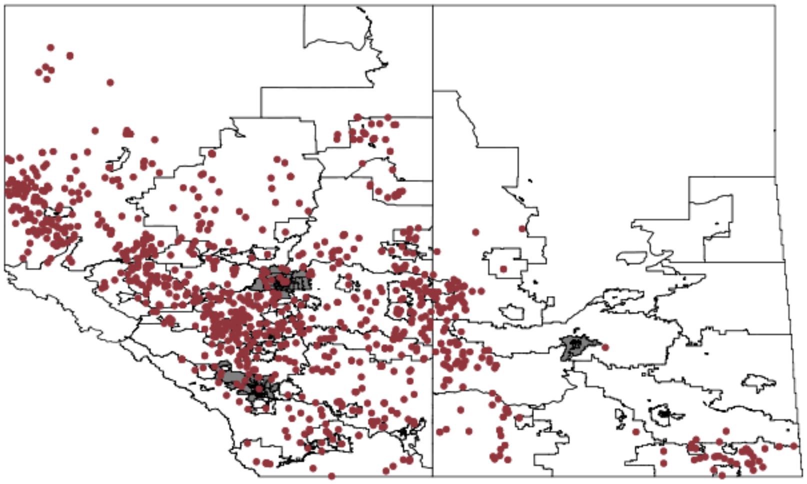


Figure 2 plots the location of oil fields in red with positive production in 2014 in the provinces of Alberta and Saskatchewan. In grey, the main cities of the provinces are drawn as conglomerates. *Data Source:* Rystad Energy.

---

[5] Bornstein, Krusell and Rebelo (2022) use the same data source to estimate a structural model of the oil industry embedded in a general equilibrium model of the world economy.

Our main goal is to identify the labor markets that are highly impacted by the large exogenous decline in global oil prices, *i.e.*, small regions where the oil industry holds disproportionate significance. To achieve this, we first identify the postal codes within a 30-mile radius of each field.[6] Then, we define as an *oil-dependent* labor market, the union of those identified postal codes within a given forward sortation area (FSA). An FSA represents the first three digits of a postal code and corresponds to a cluster of postal codes. Therefore, each FSA is divided at most into different labor markets; *oil-dependent* and *non-oil-dependent* labor markets.[7]

FSAs, which are delimited in Figure 2, are based on territory characteristics (rural vs. urban) and size of the population. Therefore, their physical dimension varies substantially. While an FSA covers a larger area in rural areas, cities have multiple FSAs. In Alberta and Saskatchewan, there are 208 FSAs, but all the rural areas are covered by 23 FSAs. Since we want to approximate a labor market that is as close as possible to a commuting zone, we treat each city as a single labor market.

Table 1: Local Labor Markets

	Oil Area	Non-Oil Area
Number of Oil Plants	1,326	0
Number of Geoareas	37	18
Number of Postal Codes	91,424	14,828
Total Population	3,526,471	668,641
Share of Population	84.06	15.94
Average Geoarea Population	95,310	37,147

As detailed in Table 1, there were a total of 1,326 oil fields in Alberta and Saskatchewan that exhibited positive oil production in the year 2014. Based on our 30-mile radius definition, we identified 37 *oil-dependent* labor market and 18 *non-oil-dependent* labor markets. Approximately 84% of the population of these two provinces resides within an area significantly exposed to the oil industry.

In our empirical strategy, that we describe in detail in section 4, we leverage the fact that areas near oil fields are disproportionately affected by shocks impacting the oil industry compared to areas farther away. Consequently, we utilize the decline in global oil prices between 2014 and 2016, coupled with distance to oil fields, as a proxy for local labor market

---

[6] In the Robustness section, we show that the results are robust to different distance specifications.

[7] Note that it's possible that an FSA corresponds to a single labor market, either an *oil-dependent* or a *non-oil-dependent* labor market.

shocks.

3 Data Overview and Description

To investigate the moving response to local labor market shocks and explore variations across demographic groups, we have gained access to *TransUnion Canada*, heretofore not used to study the effects of local labor market shocks on location choices. One of the key advantages of *TransUnion* is that it allows us to analyze how the moving response varies based on an individual's access to financial markets. A discussion of the validity of *TransUnion Canada* to study internal migration is provided by Giannone et al. (2023). We combine *TransUnion* data with other regional level statistics as reported below.

3.1 TransUnion Canada

TransUnion is a credit bureau agency that collects financial indicators of individuals monthly. The dataset encompasses information on 35 million individuals, covering nearly every individual in Canada with a credit report. Data is available from 2009 onwards. The dataset includes details on credit limits, balances, payments, and delinquency status for various credit accounts, such as mortgages, auto loans, credit cards, and lines of credit. While homeownership status is not directly observed, we can infer an individual's homeowner status if they have a mortgage account with a positive outstanding balance or if a fully amortized mortgage is linked to their current residence. Additionally, *TransUnion* provides data on date of birth and maintains a history of individuals' addresses, which is crucial for our research purposes.

Our sample is limited to individuals aged between 25 and 85 years. Individuals under the age of 25 are underrepresented in our data due to their limited credit history.[8]

Figure 3 plots migration rates across different geographic units within Canada. The blue line shows the official yearly inter-provincial migration rates from Statistics Canada. The red dash-line shows inter-provincial migration rates using the *Transunion* data.[9] Both series are very similar in magnitudes and fluctuations over time, suggesting that *Transunion* is well-suited to analyze moving in Canada. Moreover, it allows us to compute migration rates across Canadian cities at a higher frequency and for different demographic groups, which is impossible using official migration statistics. The green dashed line presents the migration

---

[8] Anecdotal evidence suggests that young individuals often use their relatives' addresses as their official residence during their school years. Additionally, we exclude individuals above 85 years old to avoid potential issues related to unreported deaths and to prevent the inclusion of movements to nursing homes or similar facilities. Importantly, our results remain robust to this age restriction.

[9] The number of people defines migration rate across provinces reported changing the address to a different province divided by the total number of individuals in the dataset in the previous year.

Figure 3: Migration Patterns in Canada: Census vs TransUnion

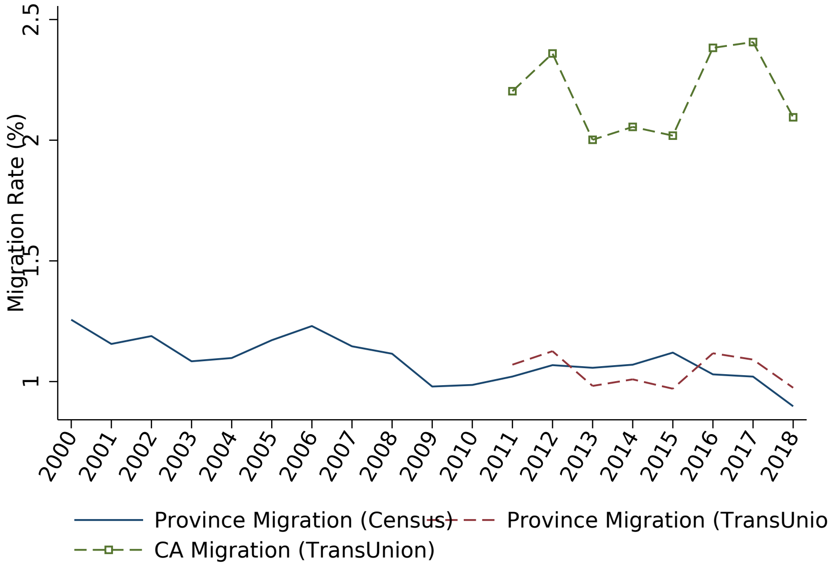


Figure 3 plots the yearly inter-provincial migration rate using Census data (solid blue line) between 2000 and 2018 and using TransUnion data (red dashed line) between 2011 and 2018. The green dashed-squared line plots the yearly migration rates among Canadian CAs using TransUnion data between 2011 and 2018. *Source:* Statistics Canada and TransUnion.

rate between census areas (CA)[10,11]. Between 2011 and 2018, on average, 2.3 percent of the Canadian population aged between 25 and 85 moved between CAs per year.

3.2 Baseline Characteristics

One major concern in our analysis is the potential dissimilarity in population characteristics between *oil-dependent* and *non-oil-dependent* labor markets. Thus, we examine the population characteristics in these labor markets during 2012 and 2013, which constitute the period covered in our sample before the decline in oil prices. For each individual in the sample, we consider only one observation. For those who moved, we examine the quarter preceding the moving date, while for individuals who remained in the same location, we analyze the median quarter among those in which the individual is present in the sample. Table 2 reports mean

---

[10] A city is defined as a census metropolitan area (CMA) or a census agglomeration (CA) that is formed by one or more adjacent municipalities centered on a population core. A CMA must have a population of at least 100,000, of which 50,000 or more must live in the core. A CA must have a core population of at least 10,000. To be included in the CMA or CA, other adjacent municipalities must integrate with the core, measured by commuting flows derived from previous census place of work data.

[11] Migration rate across CAs is defined by the number of people reported to change the address to a different CA divided by the total number of individuals living in a CA in the previous year.

and standard-deviation in brackets for *oil-dependent* and *non-oil-dependent* labor markets in the first two columns. The third-column reports the t-tests for the mean difference between the two groups.

Overall, population in both types of labor market are very similar. The average credit score is approximately 739 in both *non-oil-dependent* and *oil-dependent* labor markets, suggesting that individuals in these areas have comparable creditworthiness. Additionally, around 60% of the population in both markets consists of Prime borrowers, individuals with a credit score exceeding 760. Population in *non-oil-dependent* labor markets is, on average, 2 years younger than in *oil-dependent* labor markets. The share of working age population (age between 25 and 64 years old) is 83 and 87% in *non-oil-dependent* and *oil-dependent* labor markets, respectively. Homeownership rate is 5 percentage points above in the *oil-dependent* labor markets, but the share of mortgage holders is 2 percentage lower which reflects into slightly higher home-equity. 84% of individuals have at least one credit product in *non-oil-dependent* labor markets against 87% in *oil-dependent* labor markets. However, both markets are very similar in terms of delinquencies and credit usage.

Overall, these findings indicate that, although there are some minor differences in population characteristics between "oil-dependent" and "non-oil-dependent" labor markets, the populations in both types of areas share many similarities, particularly in terms of credit behavior and creditworthiness.

We now turn into the average annual migration rates between 2012 and 2013 on aggregate and across different demographic groups separqtely for *oil-dependent* and *non-oil-dependent*labor markets. As reported in Table 3, the average annual migration rate in *non-oil-dependent* labor market 3.9%, while it was notably higher at 6.6% in *oil-dependent* labor markets. This 2.6 percentage point difference in aggregate annual migration rates is common across different demographic groups.

Despite these differences, as expected, migration rates decrease monotonically with age and renters move more than renters. We also find that migration rate decreases monotonically with credit score. Financial institutions widely use credit scores to determine an individual's creditworthiness and for loan underwriting and pricing. On average, borrowers with higher credit scores tend to have easier access to credit and more favorable loan terms (Beer and Li, 2018). We view high credit usage as a proxy for higher financial constraints as it is harder for individuals to increase their debt in the short run if their outstanding debt is already close to the limit. So, individuals with less ability to access financial markets are borrow move on average more than individuals less financially constrained both in *non-oil-dependent* and *oil-dependent* labor markets.

Table 2: Population Characteristics in *Oil-dependent* and *Oil-dependent* Labor Markets (2012-2013)

Variable	(1) Non-Oil Labor Market Mean/(SE)	(2) Oil Labor Market Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
Credit Score	741.636	742.716	-1.080
	(2.933)	(2.146)	
Prime (S)	0.619	0.619	0.000
	(0.012)	(0.009)	
Age	50.011	47.718	2.294***
	(0.717)	(0.237)	
Working Age (S)	0.831	0.875	-0.044***
	(0.011)	(0.006)	
Homeowners (S)	0.385	0.440	-0.055**
	(0.022)	(0.008)	
Mortgage holders (S)	0.498	0.486	0.012
	(0.007)	(0.005)	
Home-Equity	0.587	0.599	-0.012
	(0.006)	(0.005)	
Active Credit Account (S)	0.833	0.858	-0.025***
	(0.005)	(0.004)	
Deliquencies (S)	0.127	0.132	-0.005
	(0.008)	(0.003)	
Credit Limit	35270.753	34800.946	469.807
	(1676.803)	(723.105)	
Credit Usage	0.471	0.527	-0.056**
	(0.009)	(0.025)	

Table 2 reports mean and standard-deviation in brackets for *oil-dependent* and *non-oil-dependent* labor markets in columns (1) and (2), respectively, for each of the characteristics denoted in the first column, except for characteristics followed by (S) where it is reported the share of population. Data from 2012 and 2013. Column (3) reports the t-tests for the mean difference between the two groups. The value displayed for t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 3: Migration Rates in *Oil-dependent* and *Non-Oil-dependent* Labor Markets (2012-2013)

Variable	(1) Non-Oil Labor Market Mean/(SE)	(2) Oil Labor Market Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
All	0.072	0.081	-0.009
	(0.008)	(0.004)	
Non-Prime	0.094	0.103	-0.010
	(0.011)	(0.005)	
Prime	0.056	0.066	-0.010
	(0.006)	(0.003)	
Credit Score [1-639]	0.090	0.099	-0.009
	(0.012)	(0.005)	
Credit Score [640-759]	0.077	0.088	-0.011
	(0.009)	(0.004)	
Credit Score [760-799]	0.044	0.053	-0.009*
	(0.005)	(0.003)	
Credit Score [800+]	0.068	0.078	-0.010
	(0.008)	(0.004)	
Young	0.078	0.092	-0.014
	(0.008)	(0.005)	
Old	0.031	0.026	0.005
	(0.006)	(0.002)	
Age [25-35]	0.103	0.123	-0.020
	(0.014)	(0.008)	
Age [36-45]	0.054	0.069	-0.015**
	(0.006)	(0.004)	
Age [46-65]	0.074	0.084	-0.010
	(0.007)	(0.004)	
Age [66-85]	0.031	0.026	0.005
	(0.006)	(0.002)	
Homeowners	0.050	0.063	-0.014**
	(0.004)	(0.003)	
Renters	0.088	0.097	-0.009
	(0.010)	(0.005)	

Table 3 reports the annual out-migration rates from local markets in *oil-dependent* and *non-oil-dependent* areas. Data from 2012 and 2013. Column (3) reports the t-tests for the mean difference between the two groups. The value displayed for t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

4 The Moving Response to the Oil Price Collapse

Before assessing formally the impact of the oil shock on moving decisions, we study the flows from and into the *Oil Provinces*. Figure 4 plots migration rates for *Oil Provinces* and *Non-oil Provinces* between 2000 and 2018 using official statistics from Statistics Canada. Outflow rate (Panel A) and Netflow Rate (Panel B) has been very stable for *Non-oil Provinces* throughout the entire period. The *Non-oil Provinces*show a nearly constant Outflow rate of 1% that seems to be compensated by a constant inflow of similar magnitude. However, migration ratios for *Oil Provinces* are much more volatile and of higher magnitudes. The outflow was around 2.5% per year until 2005 when started to decline and reach its lowest value of 2% in 2013. After 2013, the outflow rate followed the oil price pattern. While oil prices declined between 2013 and 2016, the number of people leaving the *Oil Provinces* increased. The pattern reversed when oil prices started recovering. More striking is the behavior of the netflow rate during the same period. In 2012, the netflow rate was positive around 1% and reached the negative level of -0.25% in 2016. These results are suggestive that individuals react to oil shocks by leaving at a higher rate the *Oil Provinces* but above all negative oil shocks seem to reduce the incentives to migrate into these provinces. The high correlation between oil prices and migration flows both in terms of the direction and timing presented in this figure gives us confidence that oil shocks are an important driver of individuals' migration decisions in the regions with higher exposure to the oil industry. This also suggests that the changes in the migration rates at national level are coming mostly from the oil regions.

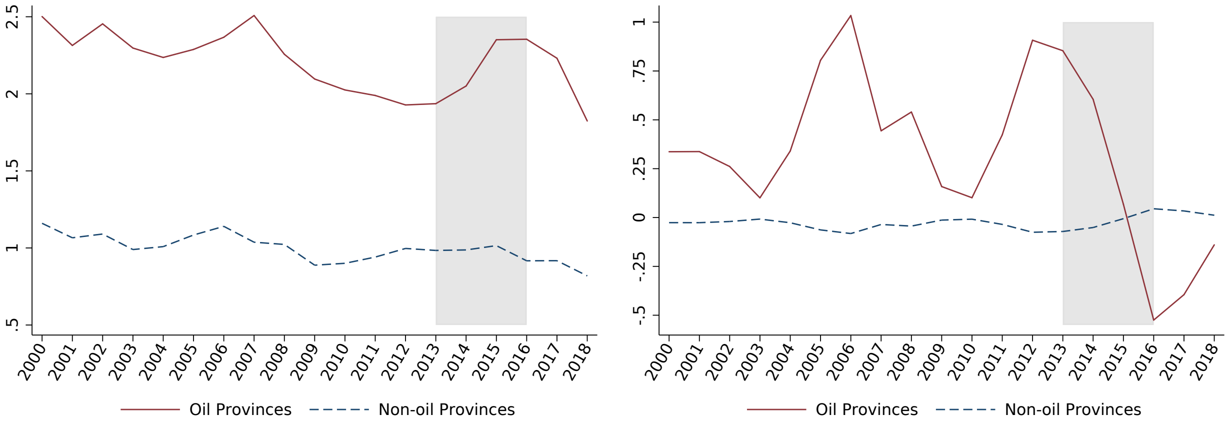
4.1 Empirical Specification

To examine the impact of local labor market shocks on individual moving choices, we implement following differences-in-differences (DID) specification:

$$Y_{i,z,t} = \beta_0 Oil\ Market_z \times Post_t + \beta_1 X_{i,z,t-1} + \delta_z + \theta_t + \epsilon_{i,z,t} \tag{1}$$

where $Oil\ Market_z$ is a dummy variable that equals 1 if location z is classified as an *oil-intensive* area and 0 if it is an *non-oil-intensive* where the *oil-intensive* areas are in Alberta and Saskatchewan. $Post_t$ is dummy variable that equals 1 in 2015 and 2016 and 0 prior to 2015. Although oil prices started declining in 2014Q3, we initiate the post-period from 2015Q1, acknowledging that the decision to move may entail some time. In the appendix, we show that our results are robust and quantitatively similar if we exclude the year 2014 from the sample. We consider a sample period from 2013 up to 2016, but results are robust if the sample is expanded to 2017. Data is quarterly.

Figure 4: Migration Patterns in Canada



Panel A: Outflow Rate

Panel B: Netflow Rate

Figure 4 plots the Migration patterns in Canada between 2000 and 2018 for Oil Provinces and Non-oil Provinces. Panel A plots the Outflow Rate and Panel B plots the netflow Rate. Outflow Rate is defined by the number of people leaving a certain set of provinces divided by the total Population in the same set of provinces in the year before. Netflow Rate is defined by the difference between the number of people entering and leaving a set of provinces divided by the total Population in the same set of provinces in the year before. *Data Source:* Statistics Canada.

$X_{i,t-1}$ denotes individual characteristics, observed in the quarter preceding the decision to migrate. These characteristics include age, homeownership status, credit score, changes in credit score, and other financial-related variables such as mortgage ownership and home equity for homeowners, credit usage, delinquency status, and roll-over non-mortgage debt.

Our main specification also includes location fixed effects and time fixed effects. The time fixed effects, θ_t, absorb overall trends in moving rates and any potential aggregate shock to the economy. The location fixed effects, δ_z, control for city characteristics as amenities, long-run productivity levels, quality of life, among others. We cluster our standard errors at location level.

Our first objective is to investigate whether a local labor market shock, represented by the decline in global oil prices between 2015 and 2016, influenced individuals' decisions to move. To achieve this, our main variable of interest, $Y_{i,z,t}$ is a dummy variable that equals 100 if individual i in location z at time t changes location in that quarter and 0 if they remained in the same location. Our key coefficient of interest is β_0, which assesses whether the decline in global oil prices had a differential impact on individual moving decisions in *oil-intensive* labor markets (treatment group) compared to *non-oil-intensive* labor markets (control group).

4.2 Aggregate Moving Response to a Local Shock

Table 4 and 5 present the baseline estimates of equation (1) for the 2013-2016 period. The crucial difference between the two tables is that in table 4, we run the conventional exercise in which a move is considered leaving the labor market. In table 5, instead, we consider a move and a location change to a different a different labor market or to a different neighborhood within the labor market. This is key to identify our "local moving¨ channel.

In both tables, the regressions in columns (1) and (2) are estimated using ordinary least squares (OLS) without controls and with controls for individual characteristics, respectively. In both cases, we find that the decline in oil prices led to increased moving across all labor markets in the *Oil Provinces*. However, this moving response was more pronounced in labor markets with higher exposure to the oil industry.

In columns (3) and (4), we cumulatively introduce controls for labor market fixed effects and time-fixed effects. These controls account for systematic differences in moving rates across locations and capture aggregate trends over time. Importantly, controlling for these factors has a positive but small impact on the magnitude and precision of the coefficients of interest.

Table 4: Impact of Local Shocks on Moving without "The Local Moving Channel"

	(1)	(2)	(3)	(4)
		Moving Dummy		
oilsite	-0.218	-0.264		
	(0.195)	(0.183)		
post	0.075***	0.077***	0.082***	
	(0.014)	(0.019)	(0.019)	
oilsite × post	-0.009	0.008	0.016	0.015
	(0.022)	(0.026)	(0.024)	(0.025)
Observations	57950374	46471623	46471623	46471623
Adjusted R^2	0.000	0.003	0.005	0.006
Controls		yes	yes	yes
Area FE			yes	yes
Quarter FE				yes

Table 4 reports the coefficients of regression (1) where the dependent variable is a dummy variable that equals 100 if an individual changes location in that quarter and 0 if stays. Standard errors are presented in parentheses, and are clustered at the level of the area. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Table 5: Impact of Local Shocks on Moving with "The Local Moving Channel"

	(1)	(2)	(3)	(4)
	Moving Dummy			
oilsite	0.953***	0.852**		
	(0.352)	(0.329)		
post	0.151***	0.222***	0.246***	
	(0.049)	(0.052)	(0.053)	
oilsite × post	0.300***	0.317***	0.318***	0.324***
	(0.085)	(0.092)	(0.084)	(0.086)
Observations	52725204	41410653	41410653	41410653
Adjusted R^2	0.001	0.013	0.014	0.016
Controls		yes	yes	yes
Area FE			yes	yes
Quarter FE				yes

Table 5 reports the coefficients of regression (1) where the dependent variable is a dummy variable that equals 100 if an individual changes location in that quarter and 0 if stays. Standard errors are presented in parentheses, and are clustered at the level of the area. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

When we run the conventional moving regression as in table 4, we find that the estimate on the treatment group after the shock is not statistically significant in any of the specifications. This is reconcilable with a large chunk of the literature that finds little evidence of out-moving after a local shock. Instead, when we allow for a local move, we find a significant moving response to a negative oil price shock in different neighborhoods within the same city as reported in all specifications of table 5. The shock appears to increase the propensity to move out both in *oil-intensive* and *non-oil-intensive* labor markets, but the response is 3.2 times stronger in the *oil-intensive* labor markets. This response is not only statistically significant but also economically substantial. Before the decline in oil prices, the likelihood of an individual moving in a given quarter was approximately 1.6% in *oil-intensive* areas (see Table 3). After the shock, the likelihood of moving out increased by approximately 32%.

These results are robust to extend the sample period to 2017 and by excluding 2014 from the sample. Results can be seen in Tables A.1 and A.2 in Appendix A.

5 Delving into the Mechanism: Heterogeneity and Destination Type

Putting together tables 4 and 5, we conclude that not accounting for local moves would dramatically underscore the spatial reallocation response to a local shock. A reader right now must be thinking that moving within a city or outside it are two different choices. This is why, thanks to the richness of demographics and exploring the panel dimension, we can delve into the mechanisms. To do so, we first explore the heterogeneity in demographics of the moving response and then study the choice of destination compared to the origin.

5.1 Heterogeneous Moving Response to Local Shocks

The baseline estimates show a clear aggregate moving response to a negative shock to the local labor market. In this section, we delve into the variation in moving responses to local labor market shocks across different demographic groups. Specifically, we focus on three key dimensions: i) the ability to borrow, as proxied by credit score, ii) age, and iii) homeownership status.

We estimate the specification in equation 1 separately for each demographic group and report the results in Table 6 for the specification with individual controls, location-fixed effects, and time-fixed effects. In Panel A, we categorize individuals into four credit score groups: 0-639 (very poor), 640-759 (near prime and prime), 760-799 (prime plus), and 800-900 (super prime). In Panel B, we group individuals into four age categories: 25-35, 36-45, 46-55, and 56-85. In Panel C, we distinguish between homeowners and renters.

We find large variations in moving response to local labor market shocks to different demographic groups. In Panel, we observe a clear relationship between credit score and the moving response to the local labor market shock. The moving response in the most impacted markets relative to the control group decreases monotonically with credit score. Individuals with lower credit scores are more likely to move out of the impacted regions than individuals with higher credit scores in the same location during a given period, even after controlling for other demographic characteristics such as age and homeownership status. The magnitude of the moving response is substantial. For those with credit scores below 640, the likelihood of migrating increases by a factor of eight compared to those with credit scores of 800 or above. This effect is particularly pronounced for individuals with credit scores below 640 in the impacted areas, where their likelihood of migrating increases by 50% relative to the period before the shock.

Table 6: Heterogeneous Impact of Local Shocks on Moving

	(1)	(2)	(3)	(4)
	Moving Dummy			
Panel A: Credit Score				
	0-639	640-759	760-799	800-900
oilsite × post	0.790***	0.439***	0.275***	0.100**
	(0.223)	(0.105)	(0.104)	(0.046)
Observations	5384910	15306302	6035285	14684156
Adjusted R^2	0.011	0.016	0.014	0.009
Panel B: Age				
	25-35	36-45	46-55	66-85
oilsite × post	0.744***	0.383***	0.125***	0.012
	(0.250)	(0.112)	(0.033)	(0.029)
Observations	9837465	8698830	16622515	6251843
Adjusted R^2	0.011	0.009	0.006	0.003
Panel C: Homeownership Status				
	Renters	Homeowners		
oilsite × post	0.514***	0.167***		
	(0.134)	(0.058)		
Observations	21768631	19642022		
Adjusted R^2	0.020	0.006		

Table 6 reports the coefficients of regression (1) for different subsets of the sample and where the dependent variable is a dummy variable that equals 100 if an individual changes location in that quarter and 0 if stays. Panel A splits the sample by credit score, Panel B by age and Panel C by homeownership status. Standard errors are presented in parentheses, and are clustered at the level of the area. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

These results point out that individuals with limited access to financial markets and a lower capacity to borrow to smooth out negative shocks are more likely to respond to the shock by moving. Conversely, individuals facing fewer financial constraints are less likely to use moving as a mechanism to cope with local labor market shocks.

In Panel B, we observe that the moving response to local shocks also varies substantially with age. Younger individuals, on average, are not only more mobile but also more likely to use moving as a response to local aggregate shocks. The lack of response among individuals aged 65 or older suggests that our shock is a valid proxy for a local labor market shock, as those no longer in the working age population do not appear to be impacted. Among working-age individuals, those aged 25 to 35 exhibit the highest moving response to the shock, moving approximately six times more than those aged 46 to 55. This variation in responses is not driven by potential correlations between age and homeownership or credit score, as these controls are included in the regression.

The response also varies by homeownerhsip status as can be seen in Panel C. Renters are 2.6 time more likely to move in response to the shock than a homeowner, particularly relative to homeowners with more equity in their homes.

Overall, these findings demonstrate that negative labor market shocks induce out-moving from the most impacted areas. The decision to migrate as a response to negative shocks is more pronounced among young individuals, renters, and those with limited access to financial markets. This heterogeneity in moving responses underscores the importance of considering demographic factors, financial constraints, and homeownership status when analyzing the impact of local labor market shocks on individual moving decisions.

5.2 Where are movers going?

In this section, we aim to further understand how moving serves as a mechanism to smooth out negative shocks and why this response varies depending on individual characteristics. Specifically, we analyze the destination choices of movers and whether these patterns change during the shock period. We investigate whether individuals are more likely to move to areas with higher income than their previous locations and whether house prices play a role in their moving decisions. We also explore whether these responses vary across demographic groups.

To formally answer these questions, we run the following specification using OLS:

$$\mathbb{1}[Y_{i,z',t+1} - Y_{i,z,t} > 0] = \beta_0 \, Oil\ Market_z \times Post_t + \beta_1 X_{i,z,t-1} + \delta_z + \theta_t + \epsilon_{i,z,t} \tag{2}$$

where $\mathbb{1}[Y_{i,z',t+1} - Y_{i,z,t}]$ equals 100 if an individual moved from location z to location z' and the variable of interest Y is larger in the new location. In particular, we compare locations in terms of house prices and population size.[12] We also consider the case cases in which $\mathbb{1}[Y_{i,z',t+1} - Y_{i,z,t}]$ equals 100 if the new location is outside the *Oil Provinces* and if the new location is a rural area. We obtain monthly House Price Index data at Forward Sortation

---

[12] We are currently in the process of obtaining income measures at FSA level.

Area (FSA) level from Teranet.[13]

The specification outlined in equation (2) closely resembles equation (1) but with two main differences. First, the dependent variable differs, and second, the sample is limited to individuals who have moved. Consequently, we compare the relocation choices of individuals *oil-intensive* areas before and after 2015 with the behavior of the movers in the *non-oil-intensive* areas. The results are presented in Table 7, which reports estimated coefficients after splitting the sample of movers into two groups: those who move to other locations within Alberta and Saskatchewan and those who move to locations outside these two provinces.

Panel A reports the the likelihood of individuals moving to locations with higher housing costs. Regardless of whether individuals move within or outside the *Oil Provinces*, those in oil-intensive labor markets exhibit a greater propensity to relocate to areas with more affordable housing as oil prices decline. Although the coefficient is more pronounced for individuals moving within the *Oil Provinces*, the difference is insignificant.

We don't find a change in destination after the shock regarding the size (population) of the destination neither the location structure (rural vs urban).

These findings suggest that housing costs are a pivotal factor in moving decisions following a negative local labor market shock. In response to such shocks, individuals are more inclined to move away from the affected areas to places where housing is more affordable, possibly at the expense of their long-term labor market outcomes.[14]

6 A Dynamic Spatial Equilibrium Model with Local Shocks

To understand how local aggregate shocks affect aggregate welfare and welfare inequality and to quantify the importance of moving as a mitigation channel, we develop a dynamic life-cycle model of location choice with uninsurable income risk and wealth which can be accumulated through illiquid housing and a liquid asset similar to the one developed by Giannone et al. (2023).

---

[13] Teranet provides house price index at FSA level, however, Teranet often estimates a single index for a set of rural FSAs within a province. Therefore, there is limited variation in house price index across rural areas within provinces which is a problem for the analysis we want to perform. We are there more confident in comparing house prices across provinces.

[14] We are now in the process of obtaining FSA level income data, so soon we will be able to test this hypothesis.

Table 7: Impact of Local Shocks on Moving Destinations

	(1)	(2)	(3)	(4)	(5)	(6)
	Move within Oil Provinces			Move outside Oil Provinces		
Panel A: Move to Higher House Price Locations						
oilsite	-16.337			4.772		
	(12.895)			(5.101)		
post	0.990	1.011		3.905***	3.395***	
	(0.710)	(0.752)		(0.802)	(0.823)	
oilsite × post	-1.999**	-1.499*	-1.495*	-1.494	-0.987	-1.007
	(0.846)	(0.822)	(0.820)	(0.945)	(0.968)	(0.964)
Observations	979089	979089	979089	184622	184622	184622
Adjusted R^2	0.028	0.329	0.329	0.008	0.113	0.114
Panel B: Move to Rural Areas						
oilsite	-14.429***			0.601		
	(4.243)			(3.890)		
post	-0.559	-0.633		-1.602***	-1.222**	
	(0.405)	(0.404)		(0.576)	(0.542)	
oilsite × post	0.703	0.987**	1.002**	0.266	0.017	-0.010
	(0.425)	(0.422)	(0.422)	(0.656)	(0.625)	(0.621)
Observations	979089	979089	979089	184622	184622	184622
Adjusted R^2	0.033	0.092	0.092	0.012	0.035	0.035
Panel C: Move to Larger Areas						
oilsite	-15.005			-22.028***		
	(12.264)			(5.017)		
post	0.214	-0.220		1.821***	1.899***	
	(0.645)	(0.431)		(0.634)	(0.624)	
oilsite × post	-1.363	-0.070	-0.071	0.456	0.899	0.905
	(0.850)	(0.548)	(0.549)	(0.762)	(0.661)	(0.657)
Observations	979089	979089	979089	184622	184622	184622
Adjusted R^2	0.023	0.514	0.514	0.032	0.138	0.138
Controls	yes	yes	yes	yes	yes	yes
Area FE		yes	yes		yes	yes
Quarter FE			yes			yes

Table 7 reports the coefficients of regression (2) for different different dependent variables. In Panel A, the dependent variable is a dummy that equals 100 if an individual moves to a location with higher house prices. In Panel B, the dependent variable is a dummy that equals 100 if an individual moves to rural area. In Panel C, the dependent variable is a dummy that equals 100 if an individual moves to a larger location in terms of

6.1 Space

The economy is defined by R regions indexed by $r = \{1, 2, ..., R\}$. Regions differ in exogenous productivity (z^l) and labor market risk. Each region is composed by A residential areas indexed by $a = \{1, 2, ..., A\}$ that differ in amenities (A^l) and housing supply characteristics. We done each location pair (r, a) by l such that $l = (r, a)$ and $l = \{1, 2, ..., R \times A\}$. Location subscripts are omitted unless necessary.

6.2 Household Environment

Demographics The economy is populated by a measure-one of continuum finitely-lived households. Age is indexed by $q = \{1, 2, ..., Q\}$. Households live at most Q periods, but face mortality risk with the survival probabilities, $\{\lambda_q\}$, varying over the life cycle. Population in the entire economy is constant and normalized to one. Newborns are distributed across locations according to $G(l, a)$. Households work in the initial $\bar{Q}$ periods and retire after that.

Preferences Households value non-durable consumption c, housing services s and location-specific amenities A. The instantaneous utility function u_q is given by:

$$u_q(c, s, A) = \frac{e_q[(1-\alpha)c^{1-\gamma} + \alpha s^{1-\gamma}]^{\frac{1-\sigma}{1-\gamma}} - 1}{1-\sigma} + A, \tag{3}$$

where α measures the relative taste for housing services, $\frac{1}{\gamma}$ measures the elasticity of substitution between housing services and non-durable consumption, and $\frac{1}{\sigma}$ measures the intertemporal elasticity of substitution. Non-durable consumption is the numeraire good in the economy. The instantaneous utility function is age-specific as the exogenous equivalence scale, $\{e_q\}$, captures deterministic changes in household size and composition over the life cycle. Households leave bequests to future generations when they die. These are captured by a warm-glow bequest motive a la De Nardi (2004):

$$\varphi(a) = \bar{\varphi}\frac{(a + \underline{a})^{1-\sigma} - 1}{1-\sigma} \tag{4}$$

where $\bar{\varphi}$ captures the intensity of the bequest motive and $\underline{a}$ determines the curvature of the bequest function and hence the extent to which bequests are a luxury good.

Endowments Households receive a labor income endowment $y^l_{i,q}$ given by

$$\log\, y^l_{i,q} = \begin{cases} \log\, w^l + \chi_q + \epsilon_i & \text{if } q \leq \bar{Q} \\ \log\, w_{ret} + \chi_q & \text{if } q > \bar{Q} \end{cases} \tag{5}$$

Income process for working-age households ($q \leq \bar{Q}$) has three components. First, the region-specific wage, w^l, that is endogenously determined and depends on the local productivity. The last two components reflect individual labor productivity. A deterministic age component χ_q common across locations which captures the hump-shaped pattern in average labor income over the life-cycle, and an idiosyncratic component ϵ_i that follows a first-order Markov chain on the space $\{\epsilon_1, ..., \epsilon_S\}$. We assume $\epsilon_0 = 0$ and interpret this realization of the shock as unemployment. The Markov chain for $\epsilon > 0$ is common across locations but the transition to $\epsilon = 0$ differs across locations. Therefore, the employment status Markov transition matrix Π^l is region-specific. The initial employment status is drawn from the stationary distribution π^l. If unemployed, households receive an unemployment subsidy, w_u, common across locations.

When moving, a household's income is a combination of their income in the previous location and income of the new location linked to the households' income shock drawn from the new location stationary distribution. Explicitly, a household that moves from location l with productivity state ϵ to location j' will receive in the period of the move $\tilde{y}^{l'}_{i,q+1} = (1 - \upsilon)y^l_q(\epsilon) + \upsilon y^{l'}_{q+1}(\epsilon')$. This assumption can be interpreted as households moving within the period which is assumed to be two years. It also implicitly makes moving costs dependent on individual income and location productivity. If $w^l < w^{l'}$, lower υ implies higher forgone income from moving, which can be interpreted as higher moving costs. Moving to less productive locations is then associated with lower moving costs. Similar implicit moving costs are also present in Bilal and Rossi-Hansberg (2021) and Favilukis, Mabille and Van Nieuwerburgh (2023).

Upon retirement, households receive a retirement benefit w_{ret}, common across locations, and the deterministic age profile component. Households are born with an endowment of wealth that is drawn from a location-specific exogenous distribution and that correlates with initial income.

Housing Housing services can be acquired through either renting ($d = 0$) or owning ($d = 1$). Households have a higher preference for homeownership: owning a house of size h provides $s = \omega h$ units of effective housing services with $\omega \geq 1$, while a rental property of the same size only provides $s = h$ units of housing services. Owner-occupied and rental housing sizes belong to two finite sets, $\mathcal{H}^H$ and $\mathcal{H}^R$, respectively. Rental units are weakly smaller than owner-occupied houses.

A household in location l pays $R^l h$ per period to rent a house of size h and $p^l h$ to purchase a house of the same size. Ownership carries a maintenance cost of $\delta p^l h$ which fully offsets physical depreciation and a property tax of $\tau_h p^l h$ per period. When buying a house, households face a proportional transaction cost of $F p^l h$. Renters can adjust their housing consumption costlessly.

Liquid Asset and Wealth Agents can borrow or save through an one-period financial asset b in the international financial market. Positive savings have a fixed exogenous return r common across locations. Borrowing is allowed at a fixed exogenous cost $r + \iota$, with $\iota \geq 0$, common across households. For simplicity, we define $r^b = r\mathbb{1}[b \geq 0] + (r + \iota)\mathbb{1}[b < 0]$. Renters face a limit to unsecured borrowing of $\underline{b}$. Homeowners can use their housing as collateral but borrowing cannot exceed $\underline{b} + \xi p^l h$. The borrowing constraint is summarized by:

$$b' \geq \underline{b} + \mathbb{1}[d = 1]\xi p^l h \tag{6}$$

Wealth a is the sum of household's financial wealth b and housing value $p^l h$ if homeowner:

$$a = b(1 + r) + \mathbb{1}[d = 1]p^l h$$

Location Choice Households receive idiosyncratic location preference shocks and decide where to reside. We assume that every period agents draw a vector of L independent Type 1 Extreme Value location shocks with a scale parameter ν. If households decide to move, they an utility moving cost which depends on the distance between the origin and destination locations. Specifically, utility cost of moving from location $l = (r, a)$ to $l' = (r', a')$, $\tau^{l,l'}$, is given by:

$$\tau^{l,l'} = \tau_0\mathbb{1}[a \neq a'] + \tau_1\mathbb{1}[r \neq r'] \tag{7}$$

where $\mathbb{1}[a \neq a']$ is an indicator function that equals one if households moves to a different location ($a \neq a'$) within or outside of the current region r. $\mathbb{1}[r \neq r']$ equals one if moves to a different region. We depart from most of the literature by assuming homogeneous moving costs, *i.e.*, moving costs do not on households' characteristics as age or homeownership status. However, as we will show later, in the presence of income risk and wealth, the benefits of moving depend on individual states generating distinct moving patterns for different demographic groups consistent with the data despite the homogeneous moving costs.

Government The government revenues, captured by the function $\mathcal{T}(.)$, come from a progressive labor income tax schedule and a proportional property tax τ_h levied on house values. Government revenues also include the sale of new land permits for construction which are described in section 6.4. On the costs side, the government pays the pensions of retired households. Net tax revenues, which are always positive, finance a public good that is not valued by households.

Timing At the beginning of a period, a vector of idiosyncratic location preference shocks realizes and location choices are made. Moving costs are paid if moving occurs. Households observe their idiosyncratic income state and choose between renting and owning. Households simultaneously choose non-durable consumption, housing services and liquid assets subject to the borrowing constraint. Homeowners pay a transaction cost in case housing consumption differs from the previous period or moving has occurred. Homeowners also pay maintenance costs and property taxes. At the end of the period, the death shock is realized. Households that die leave accidental bequests.

6.3 Households' Decisions

Households take as given the aggregate state of the economy that includes wages w_t^l, housing prices p_t^l, rental prices R_t^l and previous housing stock H_{t-1}^l across all locations. Households form beliefs about the evolution of the aggregate variables.[15] The household's individual state variables are the individual wealth at the beginning of the period a_t, the idiosyncratic income shock ϵ_t, age q and the variable $\bar{h}_t$ that incorporates the housing tenure status (d_{t-1}), housing consumption and location in the previous period. $\bar{h}_t$ equals housing consumption in the previous period h_{t-1} if the household was a homeowner $(d_{t-1} = 1)$ that did not move $(l_t = l_{t-1})$ and zero otherwise. In a compact way, $\bar{h}_t$ is given by $\bar{h}_t = h_{t-1}\mathbb{1}[d_{t-1} = 1 \cap l_{t-1} = l_t]$.

At the beginning of a period but after location choice is made, households in a given location l chooses between being a renter $\left(d_t^l(a_t, \epsilon_t, q_t, \bar{h}_t) = 0\right)$ and a homeowner $\left(d_t^l(a_t, \epsilon_t, q_t, \bar{h}_t) = 1\right)$ by solving:

$$V_t^l(a_t, \epsilon_t, q_t, \bar{h}_t) = \max\left\{V_t^{R,l}(a_t, \epsilon_t, q_t, \bar{h}_t), V_t^{H,l}(a_t, \epsilon_t, q, \bar{h}_t)\right\}, \tag{8}$$

where V_t denotes the value function at the beginning of the period in location l, $V_t^{R,l}$ the value of renting and $V_t^{H,l}$ the value of owning.[16] The decision of renting versus owning is based on the comparison of the respective value functions.

Renters' Problem At time t, households of age q in location l with wealth a and income shock ϵ and that decides to rent choose how much to consume of non-durable good c, rental units h and liquid savings b that solves:

$$\begin{aligned} V_t^{R,l}(a_t, \epsilon_t, q_t, \bar{h}_t) = & \max_{c_t, h_t, b_t} u_q(c_t, s_t, A^l) + (1-\lambda_q)\varphi(a_{t+1}) \\ & + \lambda_q \beta \mathbb{E}_t \left\{ \max_{\{k\}_{k=1}^L} V_{t+1}^k(a_{t+1}, \epsilon_{t+1}, q_t + 1, \bar{h}_{t+1}^k) - \tau^{l,k} + \nu\tilde{\epsilon}_{t+1}^{i,k} \right\} \end{aligned} \tag{9}$$

---

[15] Alternatively, we could define the state variable as the distribution of households across age groups, housing tenure and wealth across locations. We assume rational expectations.

[16] Value functions are indexed by subscript t to reflect potential changes in the aggregate state.

$$
\begin{aligned}
\text{s.t.} \quad & c_t + R^l_t h_t + b_t = y^{\epsilon,l}_t + a_t - \mathcal{T}(y^{\epsilon,l}) \\
& b_t \geq \underline{b} \\
& a_{t+1} = (1+r^b)b_t - F_m \mathbb{1}[l \neq k] \\
& s_t = h_t \in \mathcal{H}^R, \quad \bar{h}_{t+1} = 0
\end{aligned}
$$

The renter must pay R^l_t per rental unit and savings can be negative but subject to the borrowing constraint. The continuation value has two components. With probability $1-\lambda_q$ the household dies and leaves bequests. With probability λ_q the household survives and after the vector of idiosyncratic location preference shocks $\bar{\epsilon}_{i,t}$ is observed, the household decides the new location. The next period's wealth consists of $a_{t+1} = (1+r)b_t$. $\mathbb{E}_t$ corresponds to expectation over idiosyncratic location preference shocks, idiosyncratic productivity shocks and aggregate state across all locations.

Homeowners' Problem At time t, a household of age q in location l with wealth a and productivity shock ϵ and that decides to own their housing services chooses how much to consume of non-durable good c, owned housing units h and liquid savings b that solves:

$$
\begin{aligned}
V^{H,l}_t(a_t, \epsilon_t, q_t, \bar{h}_t) = & \max_{c_t, h_t, b_t} u_q(c_t, s_t, A^l) + (1-\lambda_q)\varphi(a_{t+1}) \\
& + \lambda_q \beta \mathbb{E}_t \left\{ \max_{\{k\}_{k=1}^L} V^k_{t+1}(a_{t+1}, \epsilon_{t+1}, q_t + 1, \bar{h}^k_{t+1}) - \tau^{l,k} + \nu \tilde{\epsilon}^{i,k}_{t+1} \right\}
\end{aligned}
\tag{10}
$$

$$
\begin{aligned}
\text{s.t.} \quad & c_t + b_t + p^l_t h_t \left(1 + F\mathbb{1}[h_t \neq \bar{h}_t]\right) = y^{\epsilon,l}_t + a_t - \mathcal{T}(y^{\epsilon,l}) \\
& b_t \geq \underline{b} - \xi p^l_t h_t \\
& a_{t+1} = (1+r^b)b_t + p^l_{t+1} h_t \left(1 - \delta_h - \tau^l_h\right) - F_m \mathbb{1}[l \neq k] \\
& s_t = \omega h_t, \quad h_t \in \mathcal{H}^H, \quad \bar{h}_{t+1} = h_t \mathbb{1}[k = l]
\end{aligned}
$$

Homeowners' problem differs from renters' problem in two main dimensions. First, homeowners can partially finance their house purchases subject to the collateral constraint $\xi p^l_t h_t$. Second, homeowners are subject to τ_h and maintenance costs δ^l_h per unit of housing value.[17] Second, houses are illiquid assets as households face transaction costs F when buying a new house ($h_t \neq \bar{h}_t$). As in the renter's problem, next period wealth also depends on the location but besides savings and potential moving costs, next period wealth also includes the property

---

[17] As shown in equation (15) below, the physical depreciation is offset by residential investment undertaken by the construction sector. We allow property taxes to vary across locations to match the heterogeneous rental-price ratios across Canadian cities.

value at $t+1$.[18]

Moving Given that the idiosyncratic location preference shocks are *i.i.d.* over time and distributed Type-I Extreme value with zero mean, the continuation value in case of survival in equations (9) and (10) can be rewritten as

$$\lambda_q \nu \log \left(\sum_{k=1}^{L} \exp \left(\beta \mathbb{E}_t V_{t+1}^{k}(a_{t+1}, \epsilon_{t+1}, q_t + 1, \bar{h}_{t+1}^{k}) - \beta \tau^{l,k} \right)^{\frac{1}{\nu}} \right). \tag{11}$$

As shown by McFadden (1973), this assumption also implies a closed-form analytical expression to the share of movers across locations. $\mu_t^{l,k}$ denotes the share of households with the same individual state and homeownership status (d_t) that choose to move from location l to location k and it is given by:

$$\mu_t^{l,t}(a_{t+1}^{k}, \epsilon_t, q_t, \bar{h}_{t+1}^{k}, d_t) = \frac{\exp \left(\beta \mathbb{E}_t V_{t+1}^{k}(a_{t+1}, \epsilon_{t+1}, q_t + 1, \bar{h}_{t+1}^{k}) - \beta \tau^{l,k} \right)^{\frac{1}{\nu}}}{\sum_{k=1}^{L} \exp \left(\beta \mathbb{E}_t V_{t+1}^{k}(a_{t+1}, \epsilon_{t+1}, q_t + 1, \bar{h}_{t+1}^{k}) - \beta \tau^{l,k} \right)^{\frac{1}{\nu}}} \tag{12}$$

where a_{t+1}, d_t and $\bar{h}_{t+1}$ are optimal savings, housing tenure and housing consumption choices derived from agents' optimization problems.

6.4 Production

There are two production sectors in each location: a tradable good sector which produces non-durable consumption and a construction sector which produces new houses. Productivities are region-specific and labor, supplied inelastically, is perfectly mobile across sectors within region.

Final Good Sector Each region r produces a uniform final good that can be traded across locations. Productivity is region specific and has two components: (i) an exogenous location-specific TFP denoted by z^r and (ii) an endogenous agglomeration force that depends on the city size, $\bar{N}^r = \sum_a^A \bar{N}^{r,a}$. The competitive final good sector in location r operates the following technology:

$$Y^r = z^r \left(N_c^r\right)^{\eta} \left(\bar{N}^r\right)^{\zeta}$$

---

[18] For tractability, we assume homeowners trade houses every period even if they remain in the same house. However, the transaction cost F is not paid by homeowners that remain in the same location with the same housing units $\left(\bar{h}_t = h_t\right)$. Note that we could re-write the budget constraint as having $p_t^l(h_t - h_{t-1} + F\mathbb{1}[\bar{h}_t \neq h_{t-1}])$. If a household does not move and does not adjust its own-housing consumption, this term equals zero. The simplifying assumption that homeowners buy and sell their owned houses every period is innocuous in this context since we don't aim to analyze the impact of high-frequency changes in the housing market.

where N_c^r is the total effective employment in the final good sector in region l.[19] The equilibrium region-level wage in location r is then given by

$$w^r = \eta z^r \left(N_c^r\right)^{\eta-1} \left(\bar{N}^r\right)^{\zeta} \tag{13}$$

Each region constitutes a single labor market. Therefore, all households living in different locations within a region receive the same wage, $w^{r,a} = w^{r,a'}$.

Construction Sector As in Kaplan, Mitman and Violante (2020), there is a foreign-owned competitive construction sector that operates in each location the following production technology:

$$I^l = \left(z^l N_h^l\right)^{k^l} \left(\bar{L}^l\right)^{1-k^l}$$

where N_h^l is the effective labor employed in the construction sector and $\bar{L}^l$ is the amount of new available buildable land.[20] The housing investment that solves a profit maximization problem of a developer is given by:

$$I^l = \left(\frac{\kappa^l p^l z^l}{w^l}\right)^{\frac{\kappa^l}{1-\kappa^l}} \bar{L}^l \tag{14}$$

where w^l is given by equation (13) due to free labor mobility across sectors within locations. The housing supply elasticity is given by $\frac{\kappa^l}{1-\kappa^l}$.

The overall housing stock in location l evolves according to

$$H_t^l = (1-\delta) H_{t-1}^l + I_t^l. \tag{15}$$

Rental Sector Following Kaplan, Mitman and Violante (2020), we assume that risk-neutral foreign investors can arbitrage between the owned-housing market and the rental market, which connects housing prices and rents in the following way:[21]

$$R_t^l = p_t^l - \left(1 - \delta_h - \tau_h^l\right) \frac{\mathbb{E}_t p_{t+1}^l}{1+r} \tag{16}$$

---

[19] For simplicity, profits are fully taxed by the government.

[20] Government issues and sells new permits equivalent to $\bar{L}^l$ units of land to developers in a competitive market as assumed in Kaplan, Mitman and Violante (2020) and Favilukis, Mabille and Van Nieuwerburgh (2023). This implies that all rents from land ownership accrue to the government and the construction sector makes no profits in equilibrium.

[21] As presented in Kaplan, Mitman and Violante (2020), this formula can be derived from the optimization problem of a competitive rental market that can frictionlessly buy and sell housing units and rents them to households.

6.5 Equilibrium

Given the set of parameters and the exogenous interest rate r, a competitive equilibrium is a location-specific price vector $\{w_t^l, p_t^l, R_t^l\}_{l=1}^L$ and allocations, namely, housing stock and population (labor supply) consistent with the households and firms optimization and that clear the markets in each location. A stationary equilibrium is one in which all equilibrium objects are time-invariant.

7 Taking the Model to the Data

We calibrate a 4-region version of the model.We consider two regions that represent two distinct labor markets: an oil-intensive region and a non-oil-intensive region. Each region is composed by two different locations that differ in housing characteristics and amenities. For simplicity, we denote this within-region locations as low- and high-house-price locations. Due to data limitations, the oil-intensive region does not match exactly the oil-intensive areas identified in the empirical section, although the structure and flexibility of the model would allow for it. Instead, we match the oil-intensive region to the provinces of Alberta and Saskatchewan. We calibrate the non-oil intensive regions to the rest of the Canadian provinces. The low and high house price locations within each region match the neighborhoods with house prices below and above median, respectively.

First, we solve the stationary equilibrium without aggregate shocks using four main datasets. For income, employment, and other region-specific moments, we use the Canadian Census. To characterize wealth distribution, we use the Survey of Financial Security (SFC), which is a survey that provides a comprehensive snapshot of the net worth of Canadian households by collecting detailed information on households' assets, debts, income, and employment. *TransUnion Canada* is used to calibrate moving-related parameters, and house prices are from Teranet.

We implement a mix of methods to bring the model to the data. A subset of model parameters, mostly those related with city heterogeneity, are assigned externally without the need to solve for the model. The remaining parameters are chosen to minimize the distance between several equilibrium moments.

Productivity Region-level exogenous productivity measures, z^r, are obtained by inverting the equilibrium wage equation defined in equation (13). To do so, we take average wage, total employment and total population with ages between 25 and 85 years old from the Canadian Census. Each aggregate corresponds to the average value for the 2012-2014 period. Following the literature, we set the elasticity of labor demand η to 0.75 which sits right within the range of values used for this parameter. The coefficient of agglomeration forces, ζ, is set to 0.13 as in Giannone et al. (2023). This value also falls in between the estimates of agglomeration forces previously encountered. The region-specific exogenous component of productivity is reported in Panel A of Figure B.1 of Appendix B. We normalize exogenous productivities so that median annual household earnings (67,700 CAD in 2016) equals one in the model.

Amenities Location-specific amenities are internally estimated in order to match the population distribution. We define city population as the total number of individuals with age between 25 and 85 years old. We obtain population data from Canadian Census (2012-2014 average). We normalize the city population so that the total population in the economy equals one in the model. Our distribution of amenities is reported in Figure B.2 in Appendix B.

Demographics and Income Households enter the model at age 25, retire at age 65 ($\bar{Q} = 25$) and die with certainty at age 85 ($Q = 30$). There is a death probability over a household's lifetime, $1 - \lambda_q$, obtained from Statistics Canada. The income process defined in equation (5) has two exogenous components. The age-specific component replicates the average income ratio differences across age groups in the data from the 2016 Census Canada. The stochastic component of earnings $\epsilon > 0$ is modeled as an AR(1) process in logs with annual persistence of 0.91 and the standard deviation of innovations of 0.20 as in Berger et al. (2018). The transition to the unemployment state ($\epsilon = 0$) is city-specific. The city-specific employment shock transition matrices M^l are built to meet two requirements. First, the steady-state unemployment rate in each region equals the average unemployment rate between 2012 and 2014 in the data; second, the average monthly employment-to-unemployment rate equals 1.5%. Both data moments are from Statistics Canada.Labor income is taxed following the functional form in Heathcote, Storesletten and Violante (2009), *i.e.*, $\mathcal{T}(y) = \tau_y^0 y^{1-\tau_y^1}$. τ_y^0 and τ_y^1 are chosen to match the federal and provincial effective tax rates across the income distribution. We obtain $\tau_y^0 = 0.92$ and $\tau_y^1 = 0.13$, which implies a mean effective tax rate of 3.7% and 15% at the 25th and 50th percentile of the income distribution in the model against 3.1% and 13.5% in the data.[22]

Migration We estimate the utility moving costs $\tau^{l,l'}$ using data on migration rates across the calibrated regions and across locations within regions from *TransUnion*. The functional form

---

[22] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110005801

of utility moving costs, $\tau^{l,l'}$, is given by equation (7). We inform our elasticities τ_0 and τ_1 by matching the average annual migration rate between locations within region of 2.13% and the average annual migration rate between oil and non-oil regions of 0.5% for the 2012-2014 period. As reported in Table 8, the data and model values are identical up to the second decimal. τ_0 and τ_1 equal 3.41 and 1.72, respectively. The dispersion of idiosyncratic location preference shocks, ν is 0.9 as in Giannone et al. (2023), which is similar to Diamond (2016) that uses a ν equal to 1.

Wealth Distribution We collect data on wealth distribution in Canada from the 2016 SFS. Several moments of the wealth distribution are crucial to pin down the discount factor β, parameters of borrowing constraint defined in equation (6) and parameters of the bequest function defined in equation (4). Regarding the borrowing constraint, we set $\xi = 0.8$ and to match to the share of households with negative assets of 5.7% in the data, we set $\underline{b}$ to -1. The discount factor β is chosen to replicate the median wealth to an annual income of 3.83. An annualized β of 0.988 generates a median wealth-to-income ratio of 3.6 in the model. The two parameters of the bequest function, $\bar{\varphi}$ and $\underline{a}$ are chosen to match two other moments of the wealth distribution, the ratio of wealth at age 75 to wealth at age 65 and the 30th percentile of the wealth to income distribution. These two moments are in the data 0.54 and 1.41, respectively, and imply $\bar{\varphi} = 555$ and $\underline{a} = 19$. To match these moments we need three other parameters taken directly from the literature. We set the annual risk-free interest rate to $r = 1.5\%$, the borrowing wedge ι to 1% and $\sigma = 2$ to give elasticity of intertemporal substitution equal to 0.5. Initial bequests mimic the empirical distribution of wealth at the age of 25 years old across cities.

Preferences We set $1/\gamma$, the elasticity of substitution between non-durable consumption and housing in equation (3) to 1.25 based on the estimates in Piazzesi, Schneider and Tuzel (2007). The consumption expenditures equivalence scale e_q are from Auclert, Dobbie and Goldsmith-Pinkham (2019). α is set to 0.85 in line with the estimates of Berger et al. (2018). The additional utility from owner-occupied housing relative to rental housing, ω, is chosen to match the average homeownership rate of 61% (Statistics Canada).

Housing To discipline housing-related parameters, we collect data on the distribution of homeowners' property value over total wealth in Canada from 2016 SFS. From TERANET, we obtain for each city house price index, average house sale price and average rental price. We back-up house prices per housing unit in the model by matching the city-specific ratio of house prices index to the average labor income. We back-up the equilibrium housing stock in each city and consequently, construction permits, $\bar{L}^l$, by inverting equation (15). The annual depreciation rate is set to 1.5% as in Kaplan, Mitman and Violante (2020). We match the house price to rent ratio in the model to the one observed in the data, which allows us to back a city-specific property tax by inverting equation (16). Housing transaction costs, F, are set to 7% as in Kaplan, Mitman and Violante (2020). To disciple housing grids, we take advantage of the distribution of homeowners' property value over total wealth and match the average house sale price over average income by city, which gives rise to city-specific housing grids. The owner-occupied house size set, $\mathcal{H}^H$, has three elements and the rental housing size set, $\mathcal{H}^R$, has two elements with the following structure: $\mathcal{H}^{H,l} = [o_1\bar{h}^l, \bar{h}^l, o_2\bar{h}^l]$ $\mathcal{H}^{R,l} = [o_3\bar{h}^l, o_1\bar{h}^l]$. $\bar{h}^l$ is chosen to match the average house sale price over average income by city. o_1 and o_2 are set to match the 30th and 50th percentiles of the distribution homeowners' property value over total wealth. As in Kaplan, Mitman and Violante (2020) we assume that the largest rental unit coincides with the smallest unit of owner-occupied house grid. o_3 is chosen to match the average size ratio of owned houses to rental houses.

Housing Supply Elasticities To calibrate the location-specific housing price elasticities we take advantages of the estimates of city-level elasticities for Canada estimated by Giannone et al. (2023). Due to data limitations, we assume a common elasticity across locations within regions. For each region, we take the median elasticity of the cities located in each region. Figure B.3 plots housing elasticities by city.

Table 8: Internally Matched Moments

Moment	Data Value	Model Value
av. migration within regions (%)	2.13	2.11
av. migration across regions (%)	0.5	0.49
share pop. negative assets (%)	5.7	6.6
30th perc. networth/income	1.41	1.5
50th perc. networth/income	3.83	3.6
wealth age 85/wealth age 65	0.54	0.68
homeownership share	0.61	0.61
50th perc. home equity/networth	0.56	0.43
50th perc. home equity/networth	0.71	0.59
Avg size owned house /rented house	1.5	1.25

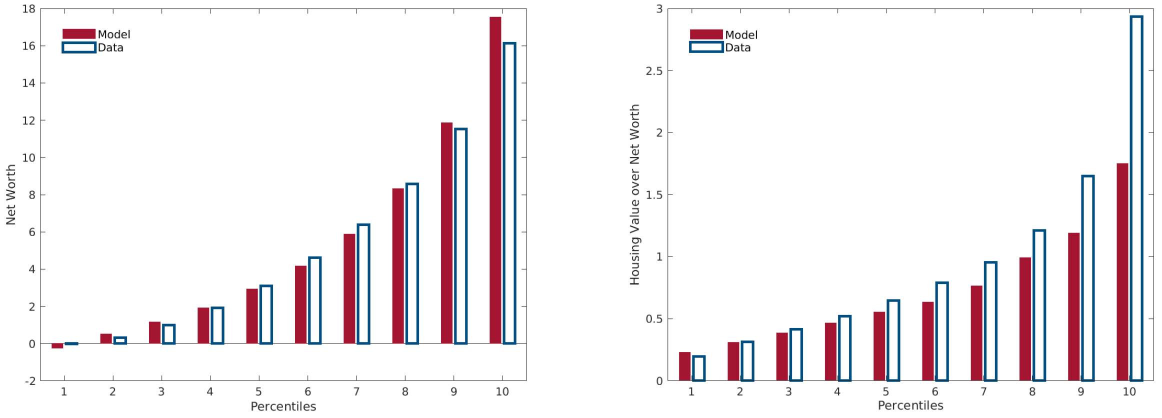
Note: Table 8 reports the thirteen targeted moments used to obtain parameters values. Data sources are described in the main text.

7.1 Model Matching Data

This section presents a set of predictions from the parameterized model in the stationary equilibrium that we did not explicitly targeted. We focus on the distributions of wealth, income and population, key moments to match heterogeneous migration patterns and to perform policy counterfactuals.

Wealth and House Value Distributions Panel A of Figure 5 plots the wealth distribution in the data and model. We explicitly target the second and fifth deciles, but the model is able to reproduce closely the entire wealth distribution in the data below the top decile. Migration decisions for households on the top of the wealth distribution are quite insensitive for individual conditions, so this shortcoming is not too problematic in our analysis. Panel B of Figure 5 reports the ratio between housing value and wealth for homeowners. Overall, the model matches closely the date but underestimates slightly the house value in terms of wealth at the top of the distribution. In Figure C.1 of Appendix C we report the wealth distribution separately by homeownership status.

Figure 5: Model vs Data: Distributions of Wealth and House Equity



Panel A: Wealth Distribution

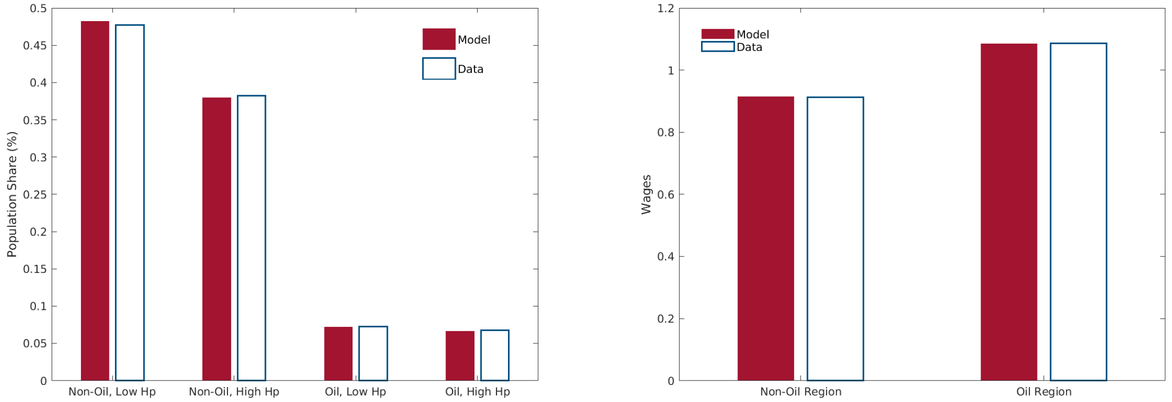
Panel B: House Value to Wealth Distribution

Note: Figure 5 plots the wealth and the house value to wealth ratio distribution. In Panel A, wealth is normalized by income. Panel B plots the distribution of household house value to wealth ratio. *Data Source:* SFS 2016.

Spatial Distribution Panel A of Figure 6 shows the population by the locations. We target this distribution in the calibration process in order to obtain city-level amenities, so not surprisingly model and data match very closely. Panel B shows the wage by city which is not targeted. Overall, the correlation between data and the model is very high.

Migration Figures 7 and 8 plots migration rates across demographic groups in the model and data. Figures 7 presents migration rates within regions while 8 plots the migration rates across regions. Only average migration rates targeted in the calibration. Despite the homogeneous migration costs, we find that the model delivers heterogeneous migration patterns across demographic characteristics consistent with the data. Panels A of both figures plot the migration rates in the model and data by homeownership status. In panels B, we observe that the migration rates by age group for in the model replicate very closely the ones in the data.

Figure 6: Model vs Data: Population and Wages across locations



Panel A: Population

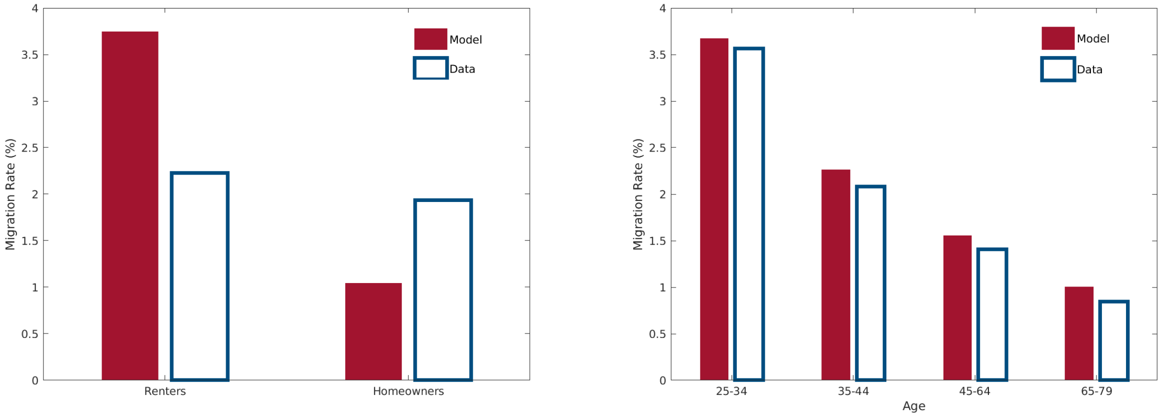
Panel B: Wages

Note: Figure 6 plots the population (Panel A) and average income (Panel B) by CMA both in the data and in the model. In both panels cities are ordered increasingly by population size. *Data Source:* Statistics Canada.

Panels C report the migration rates by wealth quartiles adjusted.In the data we have no household-level wealth information so we are not able to replicate the same migration patterns on the data. Instead, we plot the migration rates by credit score bins.

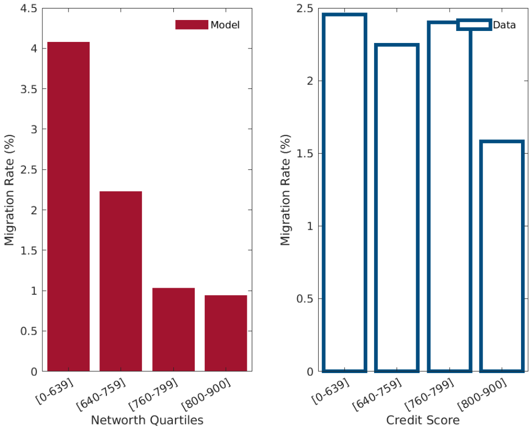
Households at the bottom of the wealth distribution are financial constrained as they are closer to their borrowing limit and have less capacity to adjust their borrowing. Households with lower credit scores are less likely to obtain credit, therefore, more financial constrained. The underlying assumption is that wealth and credit score are highly correlated. We find both in the data and in the model that migration rates decrease with wealth. For within region migration, the model predicts that households at the bottom of the wealth distribution are 4 times more likely to move than those at the top of the distribution. For across region migration, the model predicts that households at the bottom of the wealth distribution are 3 times more likely to move than those at the top of the distribution, suggesting that more constrained households are more likely to move, particularly within region.

Figure 7: Model vs Data: Migration Rates within Regions by demographics


Panel A: By Homeownernship Status

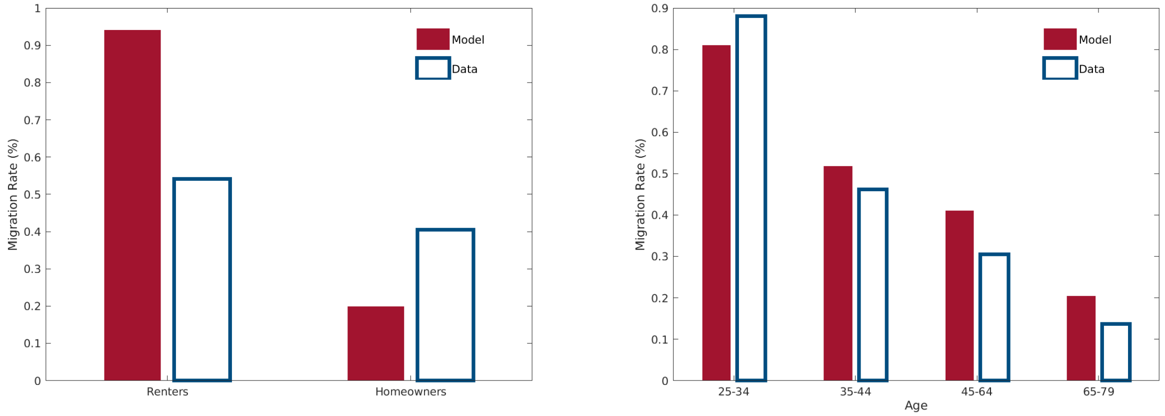
Panel B: By Age

Panel C: By Wealth



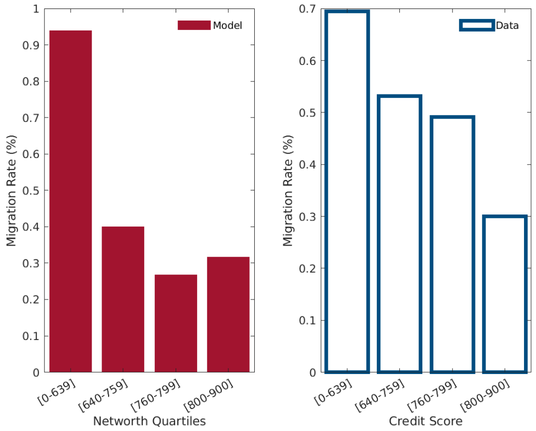
Note: Figure 7 plots the annual migration rates within regions from the model (red bars) and from the data (hollow blue bars) by demographic groups. Panel A plots it by homeownership status, panel B by age and panel C by wealth on the left (model outcomes) and by credit score on the right (data outcomes). *Data source:* TransUnion.

Figure 8: Model vs Data: Migration Rates across Regions by demographics


Panel A: By Homeownernship Status

Panel B: By Age

Panel C: By Wealth



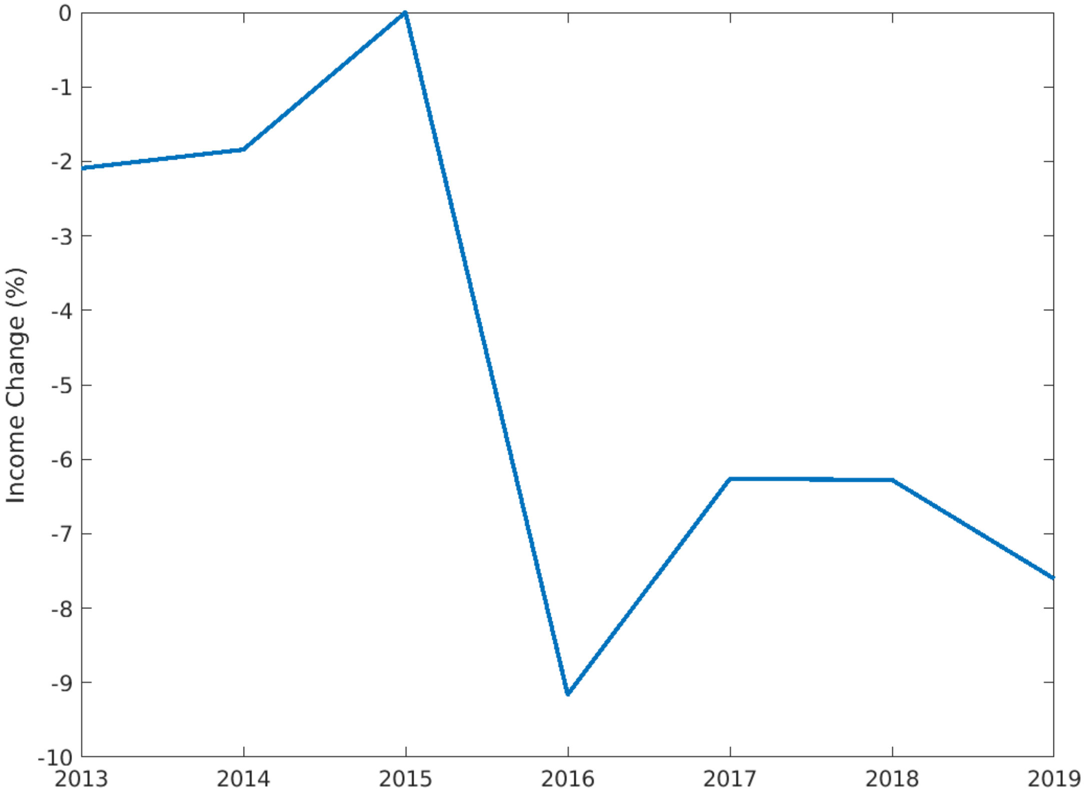
Note: Figure 8 plots the annual migration rates across Regions from the model (red bars) and from the data (hollow blue bars) by demographic groups. Panel A plots it by homeownership status, panel B by age and panel C by wealth on the left (model outcomes) and by credit score on the right (data outcomes). *Data source:* TransUnion.

8 Local Aggregate Shocks

In this section, we simulate the negative shock analyzed in the empirical section. Since we don't have an oil sector in the model, we simulate an unexpected but temporary decline in productivity in the "oil-intensive" region. The decline in productivity is calibrated to match the decline in income observed in Alberta and Saskatchewan between 2015 and 2017. Figure 9 plots the percentage change in income over time relative to 2015. Total income drop in 2016 more than 9% relative to the previous year. Although it recovered slightly in 2017 and 2018, total incomes in these two provinces remained approximately 20% lower than in 2015.

We consider two counterfactual productivity drops in the oil region. A temporary decline in productivity of 10% that reverts back to its steady-state level over course of 6 years. And a permanent decline in productivity of 10%.

Figure 9: Change in Total Income in Alberta and Saskatchewan



Note: Figure 9 plots the percentage change in total income in Alberta and Saskatchewan between 2013 and 2019 relative to 2015. *Data Source:* Statistics Canada.

With this exercise, we can interpret and rationalize the empirical estimates. Moreover, it allows us to analyze how local shocks propagate across regions and the consequences for aggregate welfare and welfare inequality.

Since our main focus is on the moving response to local shocks, we aim to quantify the importance of moving as a mitigation channel and measure the degree of complementarity between moving and other sources of insurance as access to financial markets and in response to local labor market shocks.

8.1 Temporary versus Permanent Local Aggregate Shocks

Despite the oil price shock analyzed being temporary, a transition to a greener economy may permanently impact regions highly dependent on the oil industry. Therefore, in this section, we aim to compare the effects induced by a transitory shock with those induced by a permanent one.

This counterfactual allows us to assess potential disparities relative to a temporary shock. For example, under a temporary shock, individuals with greater access to financial markets may employ this channel to smooth out the shock's impact, thereby avoiding high utility-related moving costs. However, a permanent shock could lead to greater reallocation among high-wealth individuals, potentially exacerbating long-term inequality.

9 Conclusions

In this paper, we identify and study "the local moving" channel. We find that local moving decisions are paramount in responding to a local market shock. To understand the mechanism further, we dig into heterogeneity. The main layers of heterogeneity that we study are creditworthiness, age and home ownership status. Overall, we find that less credit-worthy individuals, younger and renters more than their respective counterparts. We then study to which locations individuals go based on their initial characteristics. We find that as a response to the shock, less credit-worthy individuals, older and homeowners tend to go to locations with lower house prices.

Looking ahead, as the transition to a greener economy accelerates, local labor markets heavily reliant on emission-intensive sectors will face severe threats. Deepening our understanding of the impact of such shocks is of critical importance in designing optimal mitigation policies.

References

Albert, Christoph, Paula Bustos, and Jacopo Ponticelli. 2021. "The effects of climate change on labor and capital reallocation." National Bureau of Economic Research.

Auclert, Adrien, Hannes Malmberg, Frederic Martenet, and Matthew Rognlie. 2021. "Demographics, Wealth, and Global Imbalances in the Twenty-first Century." National Bureau of Economic Research.

Auclert, Adrien, Will S Dobbie, and Paul Goldsmith-Pinkham. 2019. "Macroeconomic effects of debt relief: Consumer bankruptcy protections in the great recession." National Bureau of Economic Research.

Autor, David H, David Dorn, Gordon H Hanson, and Jae Song. 2014. "Trade adjustment: Worker-level evidence." *The Quarterly Journal of Economics*, 129(4): 1799–1860.

Beer, Rachael, Felicia Ionescu, and Geng Li. 2018. "Are Income and Credit Scores Highly Correlated?" *FEDS Notes. Washington: Board of Governors of the Federal Reserve System.*

Berger, David, Veronica Guerrieri, Guido Lorenzoni, and Joseph Vavra. 2018. "House prices and consumer spending." *The Review of Economic Studies*, 85(3): 1502–1542.

Bilal, Adrien, and Esteban Rossi-Hansberg. 2021. "Location as an Asset." *Econometrica*, 89: 2459–2495.

Bornstein, Gideon, Per Krusell, and Sergio Rebelo. 2022. "A World Equilibrium Model of the Oil Market." *The Review of Economic Studies*, 90(1): 132–164.

Borusyak, Kirill, Rafael Dix-Carneiro, and Brian Kovak. 2022. "Understanding migration responses to local shocks." *Available at SSRN 4086847.*

Bound, John, and George Johnson. 1992. "Changes in the Structure of Wages in the 1980's: An Evaluation of Alternative Explanations." *American Economic Review*, 82(3): 371–92.

De Nardi, Mariacristina. 2004. "Wealth inequality and intergenerational links." *The Review of Economic Studies*, 71(3): 743–768.

Diamond, Rebecca. 2016. “The Determinants and Welfare Implications of US Workers’ Diverging Location Choices by Skill: 1980-2000.” *American Economic Review*, 106(3): 479–524.

Dix-Carneiro, Rafael, and Brian K Kovak. 2017. “Trade liberalization and regional dynamics.” *American Economic Review*, 107(10): 2908–46.

Favilukis, Jack, Pierre Mabille, and Stijn Van Nieuwerburgh. 2023. “Affordable housing and city welfare.” *The Review of Economic Studies*, 90(1): 293–330.

Giannone, Elisa, Qi Li, Nuno Paixao, and Xinle Pang. 2023. “Unpacking Moving: A Quantitative Spatial Equilibrium Model with Wealth.” *Bank of Canada Staff Working Paper*, 2023-34.

Hanson, Gordon H. 2023. “Local Labor Market Impacts of the Energy Transition: Prospects and Policies.” National Bureau of Economic Research.

Heathcote, Jonathan, Kjetil Storesletten, and Giovanni L Violante. 2009. “Quantitative macroeconomics with heterogeneous households.” *Annual Review of Economics*, 1(1): 319–354.

Kaplan, Greg, Kurt Mitman, and Giovanni L. Violante. 2020. “The Housing Boom and Bust: Model Meets Evidence.” *Journal of Political Economy*, 128(9): 3285–3345.

Kilian, Lutz, and Xiaoqing Zhou. 2018. “The propagation of regional shocks in housing markets: Evidence from oil price shocks in Canada.”

McFadden, D. 1973. “Conditional Logit Analysis of Qualitative Choice Behaviour.” In *Frontiers in Econometrics.* , ed. P. Zarembka, 105–142. New York, NY, USA:Academic Press New York.

Monras, Joan. 2020. “Economic shocks and internal migration.” *Working Paper.*

Notowidigdo, Matthew J. 2020. “The Incidence of Local Labor Demand Shocks.” *Journal of Labor Economics*, 38(3): 687–725.

Piazzesi, Monika, Martin Schneider, and Selale Tuzel. 2007. “Housing, consumption and asset pricing.” *Journal of Financial Economics*, 83(3): 531–569.

Topalova, Petia. 2010. “Factor immobility and regional impacts of trade liberalization: Evidence on poverty from India.” *American Economic Journal: Applied Economics*, 2(4): 1–41.

Yagan, Danny. 2014. “Moving to Opportunity? Migratory Insurance over the Great Recession.” *Working Paper.*

APPENDIX

February 2024

A Robustness - Empirical Analysis

Table A.1: Impact of Local Shocks on Migration (2012-2017)

	(1)	(2)	(3)	(4)
	Moving Dummy			
oilsite	1.473***	1.377***		
	(0.144)	(0.135)		
post	0.142***	0.172***	0.177***	
	(0.012)	(0.023)	(0.022)	
oilsite × post	0.336***	0.392***	0.426***	0.439***
	(0.034)	(0.039)	(0.039)	(0.041)
Observations	63806908	54558534	54558534	54558534
Adjusted R^2	0.002	0.012	0.015	0.016
Controls		yes	yes	yes
Area FE			yes	yes
Quarter FE				yes

Table A.1 reports the coefficients of regression (1) where the dependent variable is a dummy variable that equals 100 if an individual changes location in that quarter and 0 if stays. This specification expands the sample until 2017. Standard errors are presented in parentheses, and are clustered at the level of the area. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

Table A.2: Impact of Local Shocks on Migration (2012-2017)

	(1)	(2)	(3)	(4)
	Moving Dummy			
oilsite	1.453***	1.376***		
	(0.148)	(0.137)		
post	0.110***	0.158***	0.163***	
	(0.025)	(0.036)	(0.034)	
oilsite × post	0.364***	0.393***	0.432***	0.442***
	(0.043)	(0.048)	(0.048)	(0.049)
Observations	43690202	34794021	34794021	34794021
Adjusted R^2	0.002	0.012	0.015	0.016
Controls		yes	yes	yes
Area FE			yes	yes
Quarter FE				yes

Table A.2 reports the coefficients of regression (1) where the dependent variable is a dummy variable that equals 100 if an individual changes location in that quarter and 0 if stays. This specification expands the sample until 2017. Standard errors are presented in parentheses, and are clustered at the level of the area. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively.

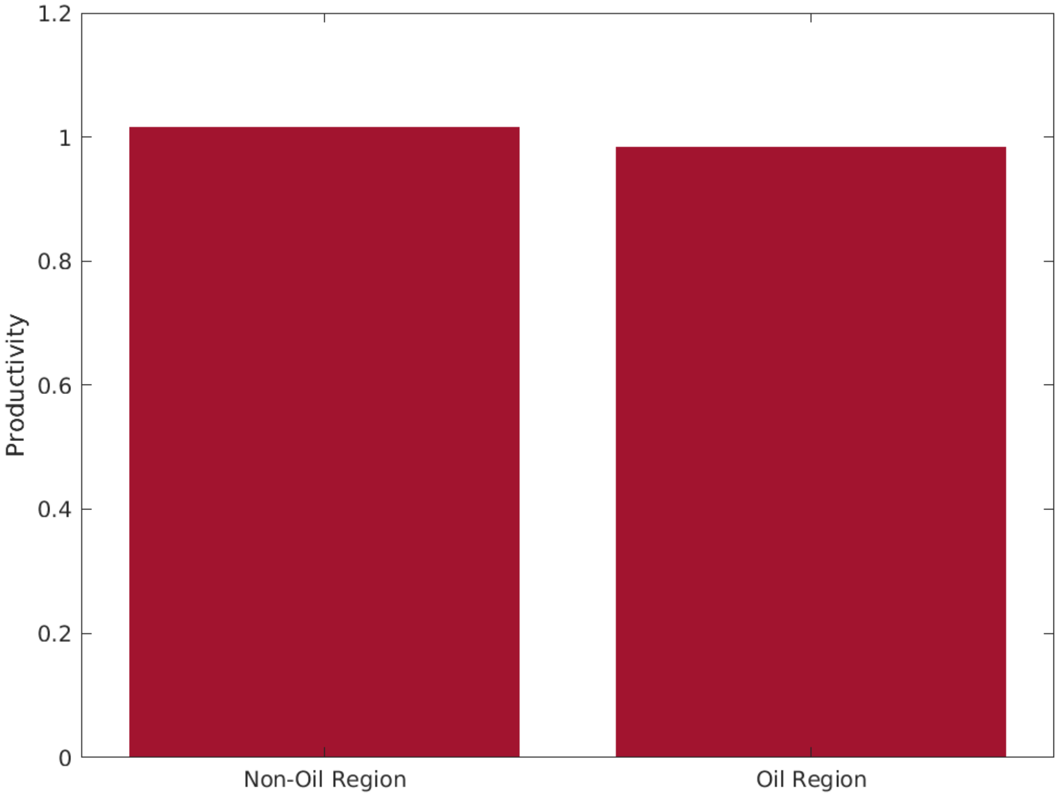
B Additional on Bringing Model to the Data

Table B.1: Parameter Values

Parameter	**Interpretation**	**Internal**	**Value**
Space			
L	Number of Locations	N	4
Demographics			
$\bar{Q}$, Q	Length of Life, Working Years	N	60, 35
λ_q	Survival probability	N	StatCan
Preferences			
α	Housing consumption share	N	0.15
β	Discount factor	Y	0.988
σ	Risk aversion	N	2
ω	Additional utility from owning	Y	1.65
e_q	Equivalence scale	N	Auclert et al. (2021)
$\bar{\varphi}$,$\underline{a}$	Bequest	N	555, 19
A	Amenities	E	Figure B.2
Endowments			
ρ_ϵ	Autocorrelation of earnings	N	0.91
σ_ϵ	S.D. of earnings shocks	N	0.2
χ_q	Life-cycle profile	N	SFS 2016
Migration			
υ	Income Dependence	Y	0.4
ν	Scale of Type 1 E.V. shocks	Y	0.9
τ_0, τ_1	Utility moving costs	Y	3.41; 1.72
Technology			
η	Labor Elasticity	N	0.75
ζ	Agglomeration Elasticity	Y	0.13
z^l	Local productivity	E	Figure B.1
Housing			
κ^l	Local housing supply elasticities	E	Figure B.3
F	Housing transaction Costs	N	0.07
Financial Instruments			
r	Interest rate	N	0.015
ι	Borrowing wedge	N	0.01
$\underline{b}$	Unsecured borrowing limit	Y	-1
ξ	Collateral constraint	N	0.8
τ_0, τ_1	Income tax	N	0.92, 0.87

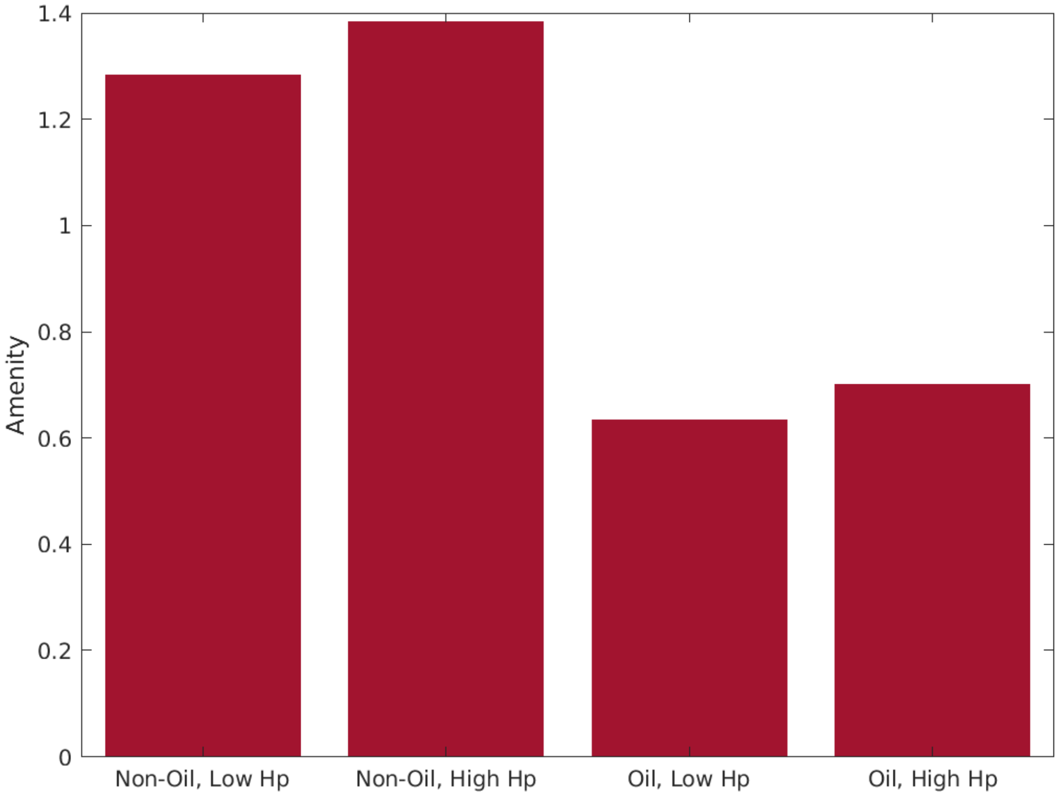
Note: Table B.1 reports the parameters' values used in the model parameterization. The third column, *Internal*, states whether the parameter was internally calibrated (Y) externally obtained (N) either by exogenous estimation or by taking directly from the literature. The model is calibrated at a bi-year frequency but all the parameters shown in this table are annualized. A unit of the final good in the model corresponds to CAD 67,700 (2016 Canadian median annual household income from Statistics Canada (StatCan)).

Figure B.1: TFP by Region



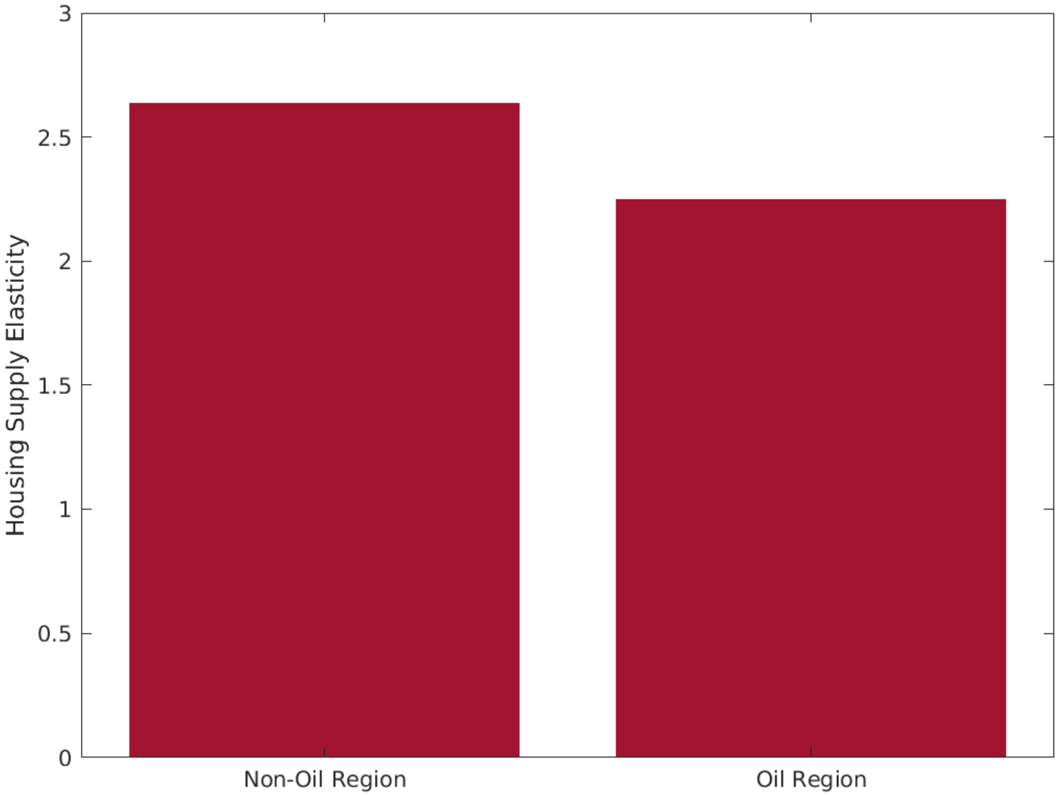
Note: Figure B.1 reports the estimates of region-level TFP obtained by inverting the wage equation in equation (13). *Data Source:* Statistics Canada.

Figure B.2: Amenity Index by Location



Note: Figure B.2 reports the estimate of the amenity index by location with the methodology explained in section 7.

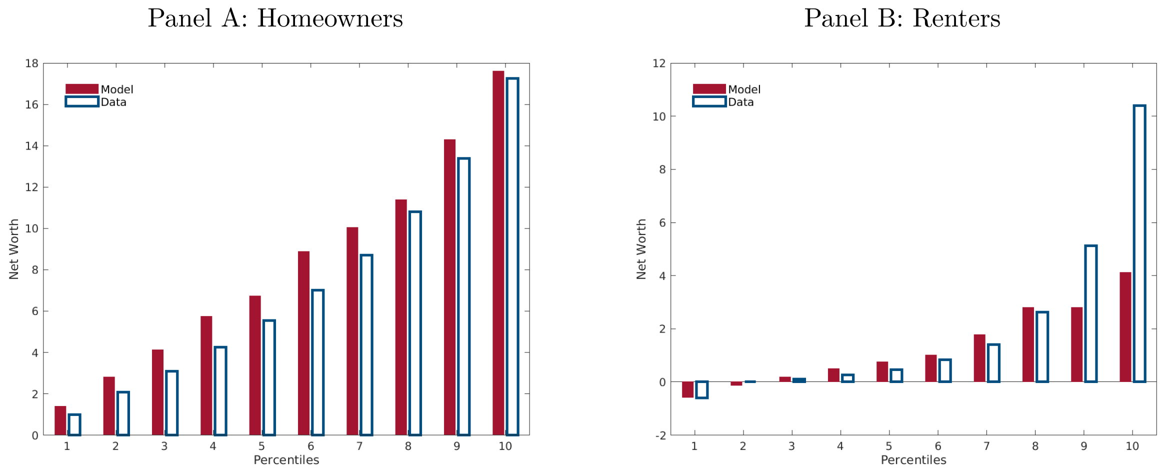
Figure B.3: Housing Supply Elasticity by Region



Note: Figure B.3 reports the estimate of the housing supply elasticities by region with the methodology explained in section 7.

C Additional on Model Matching Data

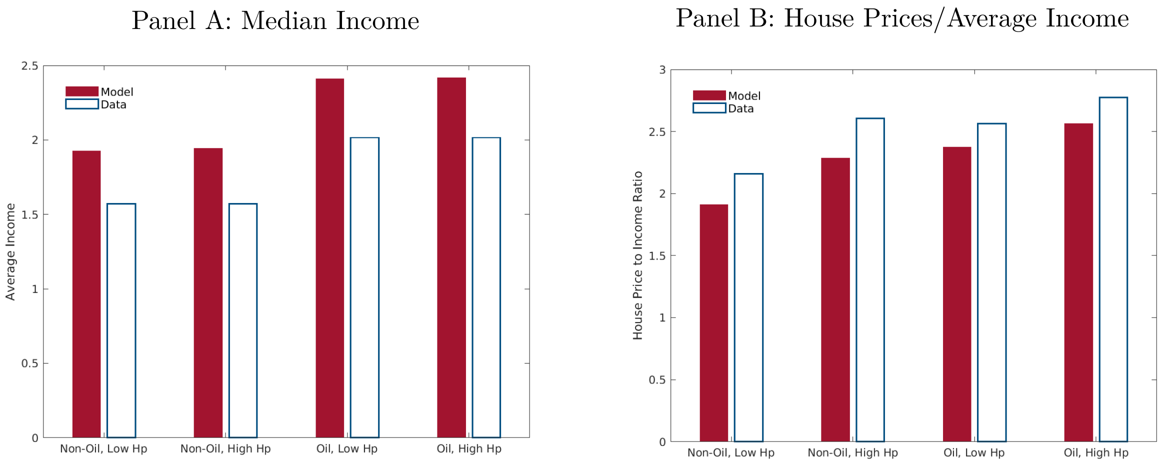
Figure C.1: Wealth Distribution by Homeownership Status


Panel A: Homeowners

Panel B: Renters

Note: Figure C.1 plots the wealth to income ratio and the house value to income ratio by CMA both in the data and in the model for homeowners (Panel A) and renters (Panel B). *Data Source:* Statistics Canada.

Figure C.2: Model vs Data: Average Income and House Prices across Locations


Panel A: Median Income

Panel B: House Prices/Average Income

Note: Figure C.2 plots the median income (Panel A) and house prices over average income (Panel B) by CMA both in the data and in the model. In both panels cities are ordered increasingly by size. *Data Source:* Statistics Canada.